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Elementary Logic

[Deduction]

Diwan Chand, M.A.

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ELEMENTARY LOGIC

DEDUCTION

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EIGHTH EDITION

Price 1-12

NARAYANA BOOK DEPOT
MESTON ROAD, CAWNPORE
1931

PRINTED BY K. P. DAR, AT THE ALLAHABAD LAW JOURNAL PRESS, ALLAHABAD.
PUBLISHED BY NARAYANA BOOK DEPOT., CAWNPORE

PREFACE TO THE FIRST EDITION

Almost every one who writes a book thinks that he fills up a blank. I too published this little book because I feel that it is needed. Whether it is wanted as well only the future can tell. I claim no credit for originality; on a subject on which so much has been written for more than two thousand years, it should be impertinent on my part to think that I can write anything new. I have tried to present the ordinary doctrines of the traditional logic in an intelligible form. The worst that a student of a Logic can do is to substitute merely mechanical work or unintelligent memorising for real mental work. As I have said elsewhere, the principal aim of the study of Logic is to *form* the mind, rather than to *inform* it. The facts will sooner or later go: only the discipline that results from the study will remain. And it is good that that alone should remain. The student must think for himself. If he can acquire this habit, he has really educated himself. Personally I am always grateful to Providence that I have a poor memory. After lecturing on the subject for about a dozen years, I cannot repeat the mnemonic verses and have to find out the special rules of the various figures. I desire to emphasize the point that Logic is not meant to cultivate the memory. Its function is to habituate a man to consecutive thought and to realise that end it must compel him

SYLLABUS IN DEDUCTIVE LOGIC

I.—PUNJAB UNIVERSITY

I.—Definition, Scope and Use of Logic. The place of Logic among the Sciences. Logical standpoint compared with the standpoints of Psychology and Grammar. The Laws of Thought.

II.—Terms and their Distinctions. Denotation and Connotation of Terms. Distribution of Terms. Predicables. Definition. The Process of Division. Logical Division distinguished from Physical and Metaphysical Division. Division by Dichotomy.

III.—Judgments and Propositions. The Classification of Propositions. Reduction of Statements to the Logical form. Import of a Proposition—the Attributive, the Predicative and the Class-Inclusion Views. Diagrammatic Representation of Propositions.

IV.—The nature of Inference. Immediate inferences—Opposition, Conversion, Obversion, Contraposition and Inversion.

V.—The Structure of the Syllogism. Rules of Syllogistic Reasoning. Figures and Moods. Special Rules of the Figures and Proof of these Rules. Characteristics of the various Figures. Reduction—Direct and Indirect. Hypothetical and Disjunctive Syllogisms. The Dilemma. Enthymemes, Sorites and Epicheiremas.

VI.—Fallacies of Deductive Reasoning.

II.—BOARD OF INTERMEDIATE EDUCATION, U. P.

Definition, Scope and Value of Logic. Nature of Thinking. The Laws of Thought. The relation of Thought and Language.

Terms and their Classification. Denotation and Connotation of Terms. The Predicables. Formal Division and Definition. Propositions and their Import. Reduction of Statements to their Logical Form. Distribution of Terms. Nature and Forms of Inference. The Opposition of Propositions and various forms of Deduction. The Syllogism; Figures and Moods. Reduction—Direct and Indirect. Hypothetical Disjunctive and Mixed Syllogisms. The Dilemma; Enthymemes, Sorites and Epicheiremas. Function and Value of the Syllogism. Analysis of Deductive Arguments. Fallacies.

CHAPTER I

DEFINITION, SCOPE AND USE OF LOGIC

1. **Definition of Logic.** When a man begins the study of a subject, his first concern is to know something about the character of the study on which he is entering. Every subject has a well or ill defined province and a knowledge of this province is appropriately enough demanded before one can enter into details. If a friend were to talk to you of the Astronomy of plants or the Botany of triangles, you would look at him intently and wonder if all was well with him. This is because you know that Astronomy deals with stars and not with plants, and that Botany studies the properties of plants and not of triangles. The study of plants does not fall within the province of Astronomy, nor does the study of triangles fall within the province of Botany. Now what is the province of Logic?

Logic studies thought. This statement should be taken with a qualification. Logic does not undertake to tell us how we think. To analyse the process of thought is the business of another science—Psychology. The relation between Logic and Psychology will be discussed in a later section: here let it suffice to say that Psychology describes and explains the actual process of thinking, without caring about the *significance* of any individual thought for knowledge. For the purpose of Psychology, all thought, be it valid or invalid, is equally respectable and worthy of study. In fact, Psychology finds it beyond its province to discuss the question of the validity of thought. For Logic, on the other hand, the distinction between valid and invalid thought is of supreme importance, and the main business of Logic consists in elucidating this distinction. *Logic seeks to tell us wherein valid thinking consists.*

Logic may take a piece of valid thought and present it to us. This, however, is not what we require. We want, not individual pieces of valid thinking, but the Laws of Valid Thought. These Laws should be distinguished from Political Laws on the one hand, and Scientific Laws on the other. A political law is a command issued by some superior authority. The command must be obeyed; if it is not obeyed, the offender may be punished. A law in science means a Uniformity or a Principle, of which the individual facts form so many illustrations. The very conception of such a law implies that it cannot be violated. The so-called exceptions to a scientific law are merely apparent. When such an exception comes to our notice, we do not believe that the law is really violated: we think rather that our previous conception of the law was not adequate, or another unsuspected law was operating along with the law which we had recognised.

A Law of Thought is neither of the nature of a *must*, nor of the nature of an *is*: its nature is best expressed by the word *ought*. No one compels you to think validly, and probably all your thoughts are not valid. If the laws of valid thought were like Scientific Laws, i.e., Uniformities of Nature, invalid thinking would be impossible, as also a knowledge of the nature of validity in Thought. We do not, as a matter of fact, always think validly, but we ought to. Accepting then the position that Logic is to discover and formulate the Laws of Valid Thought, and understanding the words, Laws of Valid Thought, to mean the principles to which thought *ought* to conform, we may define Logic as the *Science of Regulative Principles of Thought*. Laws *of* Thought mean laws *for* thought.

2. FORMS OF THOUGHT. We have used above the words Thought and Validity. Every educated man understands something by these words and the reader has probably acquiesced in their use. Logic, however, demands precision, and, before we go any further, we must know what precisely we are to understand by them. The word 'thought' is sometimes loosely used to express any form of consciousness. This is unfortunate; we have no right to designate states like *pleasure, pain, anger, fear, decision*, as 'thought'. The word 'thought' can apply only to *cognitive processes* and to some of them only. When I hear a sound, I am not thinking; nor do I think when I see a rose. Using psychological language, I am having a *sensation* or a *perception*. Even when I shut my eyes and picture before my mind's eye the image of the particular rose, I am not thinking. However, if I frame a general *idea* of the rose (referring not to any rose in particular, but applicable to all roses, indifferently), I am said to think. Again, when I declare to myself (mentally

or verbally) or to another that the rose is beautiful, I am thinking. Again, if I say that the rose is a beautiful thing, and a beautiful thing must be in my button-hole, and, therefore, the rose must be in my button-hole, my mental process is 'thought.'

Thought thus expresses itself in three forms:—

(*a*) Concept or General Idea.
(*b*) Judgment.
(*c*) Inference.

A *Concept* is framed by comparing a number of percepts and emphasizing the points in which they agree.

A *Judgment* is the affirmation or denial of a connection between two concepts.

An *Inference* is the transition of thought from one judgment or more judgments than one to a new judgment that necessarily follows from the given judgment or judgments.

3. VALIDITY implies conformity to a standard. Now what can we say about the nature of the standard in the present case? Two answers are generally given to this question. According to one view, the standard is nothing external to thought itself. *Thought, in order to be valid, should be self-consistent.* Invalidity means inconsistency or self-contradiction. According to the other view, the standard is objective, i.e., external to thought itself. Valid thought is not merely self-consistent, but also consistent with Objective Reality. This difference has resulted in dividing Logic into two distinct parts. Deductive Logic accepts Self-Consistency as the criterion of Validity, and is, therefore,

called the Logic of Consistency. Inductive Logic demands that valid thought be consistent with objective fact, and is, hence, called the Logic of Truth or Logic of Science.

In this little book, we shall confine ourselves to an introductory study of Deductive Logic.

4. LOGIC AS A SCIENCE. We have said above that Logic is to furnish us with the principles of Valid Thought. These principles are not to remain in isolation, unconnected with one another. They must by systematised. The aim of all science is to give us a body of principles organised into a system. Sometimes we talk of a scientific subject in a way that implies the existence of some unscientific subjects. No subject is scientific or unscientific *qua* that subject; each subject may be studied scientifically or unscientifically. Every boy in the village knows something about the insects, but no one is an entomologist until he systematically studies the insects. Similarly the gardener differs from the botanist inasmuch as the former does not, as the latter does, undertake a systematic study of plants. From this point of view it is absurd to ask whether Logic is a science, and perhaps not less absurd to soberly argue that it is. The sole question of practical utility is whether the principles of thought can be scientifically studied. As the following pages will show, the answer to this must be in the affirmative.

5. A MISCONCEPTION ABOUT THE FUNCTION OF LOGIC. A strange misconception has disturbed some acute minds in the past and disturbs many minds even now about the function of Logic. Some men seem to suppose that Logic under-

takes to create valid thought for us. "If syllogism[1] must be taken for the only proper instrument of reason and means of knowledge, it will follow that before Aristotle there was not one man that did or could know anything by reason; and that since the invention of syllogism there is not one in ten thousand that doth. But God has not been so sparing to men to make them barely two-legged creatures, and left it to Aristotle to make them rational.—God has been more bountiful to mankind than so; He has given them a mind that can reason without being instructed in methods of syllogisms." Thus wrote Locke, an English Philosopher of the seventeenth century. The censure is absolutely unmerited.

It escapes Locke that if God had not endowed man (and so Aristotle) with reason, the theory of Syllogism could not be worked out. Aristotle did not make men rational, but simply analysed the process of rational thought that he found them employing. The function of Logic is like the function of Grammar, which does not create a language, but simply gives a definite formulation of the principles found in the language. As Whately remarks, to credit Aristotle with having created reasoning power is nothing less preposterous than crediting Harvey with having made the blood circulate or Lavoisier with having formed the atmosphere we breathe in.

6. **LOGIC AS THE SCIENCE OF SCIENCES.** Aristotle

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[1] A form of reasoning discussed in Deductive Logic. Example: All crows are black; the bird in my hand is a crow; therefore, the bird in my hand is black.

found rational thought expressed in the talks and discourses of his contemporaries, and by examining these expressions of rational thought, he formulated the principles to which such thought conforms. And so can we today examine, in our own and in our fellows' talks and writings, pieces of valid thought, and formulate these principles. The best instances of valid thought are furnished by the sciences. In the sciences, says Joseph, "the logician can best study the laws of men's thinking: and it is in this sense that we may accept the old definition of Logic, *Scientia Scientiarum*. What the courses of the stars are to astronomy, what figures are to geometry, what plants are to botany, or the calendar of Newgate to the criminologist, that the other sciences are to the Logician: they are the material which he has to investigate, the particular facts which are given him, in order that he may discover the principles displayed in them."[1]

7. THE PLACE OF LOGIC AMONG THE SCIENCES. We have spoken of Logic as a science and also as the science of sciences. What is its place among the sciences? A science, as has been suggested above, is a systematised body of facts. The individual facts are the *matter* of a science; this matter must be given a determinate *form* before we can have a science. A college room is not merely bricks and mortar and pieces of iron and planks. It is these things *arranged in a definite manner*. The same is true of the edifices of knowledge called the sciences. An example will make this plain. I see that my pen, when I cease to support

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[1] Introduction to Logic, p. 4

it, falls to the ground. This is a piece of knowledge. I see again that a part of the moon is temporarily darkened. This is another piece of knowledge. I see again that water in the sea rises and falls at certain hours. This is a third piece of knowledge. I have got these three facts, but yet my knowledge is not scientific. Suppose, however, that I bind all these three facts together and regard them as different cases of the application of the Principle of Gravitation. My knowledge now becomes scientific. The facts are no longer isolated bits of knowledge, but parts of a system. Unscientific knowledge is ununified knowledge; and scientific knowledge is unified knowledge. However, just as we demand unity among facts that are the subject-matter of a particular science, so we demand a unity among the principles that the various sciences supply. We want to systematise the sciences themselves. This task is undertaken by Philosophy, which is for this reason sometimes called the science of sciences. Each science is only partially unified knowledge. Knowledge when completely unified is philosophy. The sciences give us separate glimpses of the Universe; they study it from different points of view. To find the place of Logic among the sciences, we must classify the sciences or arrange them according to some principle.

Auguste Comte, a French Philosopher, (1798-1857), arranges the sciences in a series, in order of decreasing generality. The most general of the sciences is MATHEMATICS. It studies the properties of space and number and its propositions would be true even if the material world did not exist.

Next comes PHYSICS. It requires matter, besides space and number. It is less general than Mathematics, because mathematical principles are applicable to physical phenomena. If all matter were of one kind, Physics would exist, but Chemistry could not exist. CHEMISTRY requires the existence of matter of various kinds and investigates the laws of their *composition* and *decomposition*. The methods employed by Chemistry are Analysis and Synthesis. We can analyse water into its constituents—Hydrogen and Oxygen, and again recombine them into water. Now in the course of our investigations, we come across things which we can analyse, but cannot produce by synthesis of their parts. A rose can be analysed like water, but we cannot form it as we can form water. Here, besides combination of parts, a new principle enters into the making of the whole. It is the principle of Life. Chemistry does not deal with it and we require a new science to study it. This new science is BIOLOGY. Biology splits into Botany and Zoology. We now come across a new phenomenon—that of consciousness and this calls into being the science of PSYCHOLOGY. Psychology considers individual consciousness or mind, but minds can and do co-operate and this fact of corporate mental life gives rise to customs, cults, religions and other phenomena of a similar character. A new Science, the most specialised of the sciences—SOCIOLOGY—investigates the products of corporate mental life.

Psychology describes and explains facts of mental life. Its function of registering and explaining facts is not unlike the function of any other descriptive and explanatory science.

It tells us how we think, how we feel pleased or pained and appreciate, and how we act. We do not, however, simply note these facts. Sometimes we are dissatisfied with the facts and wish they were different from what they are. We discriminate between things as they are and things as they *ought to be*. In the sphere of knowledge we draw a distinction between Truth and Error; in the sphere of practice, between Right and Wrong; in the sphere of appreciation, between Beauty and Ugliness. In all these cases there is a reference to a Standard or a Norm. The sciences that undertake to investigate the nature of the Standard or Norm form a separate group and are called NORMATIVE SCIENCES. The most important of them are LOGIC, ETHICS and AESTHETICS. Logic studies the standard of Valid Thought; Ethics studies the standard of Right Action; Aesthetics studies the standard of Beauty.

The arrangement of the Sciences given above may be shown in a tabular form thus—

- Mathematics
- Physics
- Chemistry
- Biology—
  - Zoology
  - Botany
- Psychology—giving rise to
  - Logic
  - Ethics
  - Aesthetics
- Sociology

Logic, according to this scheme, is *a Normative Science based on the Psychology of Cognition.* But from another point of view it may be placed above Mathematics. It is the most abstract of the sciences, for it studies principles that are applicable to all sciences, even to Mathematics. Even Mathematics must be self-consistent. The angle A cannot be greater and smaller than the angle B, any more than the same act can be at once right and wrong.

8. THOUGHT AND LANGUAGE. Language consists of a system of signs to express thought. Whenever we have a vivid idea, it seeks expression. The relation of thought and expression is so intimate that according to some psychologists thinking is only restrained speaking or acting. The cause of brutes using no language is supposed to be the poverty of thought in them; they do not talk because they have nothing to talk about. Thought is primary to language, but thought cannot pass beyond a rudimentary stage without the assistance of language.

Language, as has been remarked above, is a system of significant or interpretable signs. These signs may be gestures, spoken words, or written words. The gestures constitute the language of Natural Signs. At present they are used as a substitute for conventional language of words, when men cannot otherwise understand each other; or to supplement the conventional language. When a man finds himself in the midst of people who do not understand his language and has to convey to them the fact of his being thirsty, he will curve his hands, take them to his mouth and imitate the act of drinking. Again, a man may fold his hands and bend his head simultaneously with expressing in words his regard for another. Conventional language is superior to the language of Natural Signs inasmuch as the latter is cumbersome and is not adapted to convey fine shades of meaning. By using gestures I can indicate to another that I want him to bring me a cup of water, but I am not able to convey the idea that progress of mankind has mainly consisted in the growth of individual freedom, or that Logic is as useful a subject of study as Mathematics. Conventional language may be a system of sights, touches, smells, tastes or sounds. But a language of tastes would be exceedingly inconvenient. The number of tastes that can ordinarily be distinguished is very limited. It may be neither economical nor hygienic to be perpetually tasting things. This kind of language cannot be employed to address a number of men simultaneously. And we have also to remember that when we taste one thing, it leaves behind an effect which modifies the succeeding taste. The same considerations apply against a language of smells. Written language is a language of visible signs. It can be used by men separated from one another by long distances and can be preserved for a long time. The language of touches is used by deaf-mutes. But the most commonly used language consists of spoken words. The power of uttering sounds is acquired early in life and remains available almost to the last moments. The signs can be understood by a number of men simultaneously and may be understood in the dark or behind a screen. Words following each other do not modify each other as sounds. These are great advantages and therefore significant sounds have become the chief vehicle of expressing thought.

Language has a twofold function. It gives fixity to ideas which would otherwise be evanescent. Fixing ideas by means of words enables us to continue our mental work beyond the stage where we left it on a former occasion. The second function of language is communication of thought by one man to another. Language is a product of social life and its chief function is to serve the interests of that life. When A wants to communicate to B what is present in A's mind, he analyses the complex idea into elements with which B is already familiar. He helps B to detach elements from several wholes in B's experience, and recombine them into a new whole. It is thus that a man who has never been to the hills is enabled to appreciate the description of scenery in the hills.

9. IS LOGIC CONVERSANT WITH THOUGHT OR WITH LANGUAGE? This is one of the controversial points in Logic. Some hold that Logic has to deal with Thought and not with the instrument of its expression. This view is known as CONCEPTUALISM. Others say that Logic concerns itself with language and its function is to teach us the proper use of names, propositions and arguments. This view is known as NOMINALISM. Hamilton and Whately may be taken as representatives of these two schools. There are others, again, who maintain that Logic is concerned neither with thoughts, nor

with words, but with *things*. This view is known as REALISM (also Materialism). Mill among others advocates this view of the subject-matter of Logic.

In this connection, the following passage from Jevons will be found helpful:—

"Is the subject of logic, then, language, thought, or objects?

The simplest and truest answer is to say that it treats in a certain sense of all three. Inasmuch as no reasoning process can be explained or communicated to another person without words, we are practically limited to such reasoning as is reduced to the form of language. Hence we shall always be concerned with words, but only so far as they are the instruments for recording and referring to our thought. The Grammarian also treats of language, but he treats it as language merely, and his science terminates with the description and explanation of the forms, and varieties, and relations of words. Logic also treats of language, but only as the necessary index to the action of mind.

Again, so long as we think correctly we must think of things as they are; the state of mind within us must correspond with the state of things without us, whenever an opportunity arises for comparing them. It is impossible and inconceivable that iron should prove not to be an elementary substance, if it be a metal, and every metal be an element. We cannot suppose, and there is no reason to suppose, that by the constitution of the mind we are obliged to think of things differently from the manner in which they are.

If then we may assume that things really agree or differ according as by correct logical thoughts we are induced to believe they will, it does not seem that the views of the logicians named are irreconcilable. We treat of things so far as they are the objects of thought, and we treat of language so far as it is the embodiment of thought. If the reader will bear this explanation in mind, he will be saved from perplexity when he proceeds to read different works of logic and finds them to vary exceedingly in the mode of treatment, or at least of expression."[1]

10. **RELATION OF LOGIC TO PSYCHOLOGY AND GRAMMAR.** Psychology deals with the whole of mental life. With large tracts of this, Logic has no concern. Logic does not trouble itself about Feeling, Emotion, Memory, Imagination, Decision and so many other states. It concerns itself only with Thought. This shows that the scope of Logic is narrower than that of Psychology. Logic, however, is not a part of Psychology. Even with reference to thought, there is a well-marked difference of standpoint that separates the two sciences. Psychology tells us how we actually think: Logic tells us what makes thought valid, or how we ought to think. Psychology is descriptive and explanatory; Logic is regulative. Or to use another form of words, Psychology is a Natural Science; Logic is a Normative Science. Psychology deals with the *processes* of thought—with *conceiving*, *judging* and *inferring*; Logic deals with the *products* of these processes—the *concept*, the *judgment* and the *inference*.

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[1] Elementary Lessons, p. 10

With Logic, Thought is primary and Language is secondary. With Grammar, on the other hand, Thought is secondary and Language is primary. Grammar also cannot let thought alone; it deals with significant words. But it concerns itself more with the expression of thought than with thought itself. If a man were to write an essay, the grammarian will criticise it from the standpoint of appropriateness of words chosen, grace of style, ordinary principles of composition and so on. The logician will be anxious to see whether the piece is a good argument.

This is the main difference between Logic and Grammar. Besides this we may note that—

1. Logic recognises only one kind of sentence—the Indicative sentence. It has no concern with Imperatives, Exclamations, or Interrogations.

2. Logical analysis of the Indicative Sentence (called the Proposition) differs from the grammatical analysis. Grammatical analysis considers each word, phrase or clause by itself. Logical analysis divides a Proposition into three parts—Subject, Predicate and the Copula.

Logical analysis ends with the Term and does not take note of the parts of speech. If a Term is the Subject in a Proposition, Logic does not enquire whether it is substantive, pronoun or adjective.

3. In Grammar, the verb alone constitutes the Predicate; in Logic, the Predicate is all that is affirmed or denied of the Subject.

4. Logic recognises only one verb—*to be*—and in this also it disregards distinctions of tense.

11. WHAT IS LOGIC GOOD FOR? We have accepted the position that men do think rationally even without studying Logic; rather we have tried to emphasize the point. If this be so, where is the good of studying it? Some people have a kind of horror of the subject and when they are told that without its help they can get along well enough, they quite naturally infer that Logic is nothing more than useless intellectual gymnastics.

In the first place, it is foolish to talk of intellectual gymnastics of any kind as useless. Exercise of thought is one of the noblest of engagements that can occupy a man. The question what Logic is good for, implies that we are prepared to assign it only an instrumental value. Unless it is good for *something other than itself*, it is no good to reason, or to think about the process of reasoning. Against this we may say that the exercise of rational faculty possesses a value in itself and the study of Logic is an admirable form of this exercise. The aim of true education is not only to *inform* the mind, but also to *form* the mind. The best part of our education consists in the habit of correct thinking that we acquire. The individual facts that we deal with are sure to be forgotten sooner or later, but the disposition to accurate thought that they produce remains. And this disposition is worth any amount of learning. In training the faculty of consecutive thought, Logic has only one compeer and that is Mathematics.

Besides, Logic is of considerable practical utility to most men. Who has not often made blunders himself or been the dupe of another's clever arguing? On such occasions, who has not wished to have possessed an instrument whereby he might have been able to distinguish valid reasoning from incorrect reasoning? Logic saves us from falling into error or being deceived. It is not to be understood that a student of Logic becomes infallible; only he fares better than one who has never studied the subject. This service that Logic renders to us has so much impressed some Logicians that they prefer to speak of Logic as the Art of Reasoning. They insist that though Logic investigates and formulates the *principles* to which valid thought conforms, its chief function is to supply *rules* for the guidance of thought. Professor Minto emphasizes the negative aspect of the help that Logic gives us as being more important than its positive aspect. According to him, 'the main aim of Logic is not the attainment of truth but the organisation of reason against confusion and falsehood.' 'Logic does not so much beckon a man on to the right path as beckon him back from the wrong.' 'The existence of Fallacies calls Logic into existence,' and 'as a practical science Logic is needed as a protection against Fallacies.'

The importance of Logic for certain professions cannot be over-emphasized. The teacher must present his material in a logical order; the preacher and the rhetorician must appeal to the intellect of their hearers —only such persuation is lasting; the advocate must himself be free from self-contradiction and must be quick to see the implications of his opponent's statements.

Shall we say in the end that the study of Logic can be carried on without any Laboratory or appliances? It is an exceedingly cheap and refined mental exercise.

12. DIVISIONS OF THE SUBJECT. Using nominalistic terms, we may say that the treatment of Deductive Logic falls into the following parts:—

1. The Logic of Terms.
2. The Logic of Propositions.
3. The Logic of Arguments.

We shall study the subject according to this plan; but before we begin this, our main task, let us have a short introductory chapter on the Laws of Thought.

CHAPTER II

THE LAWS OF THOUGHT

1. **The Laws of Thought.** By the Laws of Thought we mean the principles to which all valid thought conforms.

Three such principles have been accepted since the time of Aristotle. They are the following:—

1. The Principle of Identity.
2. The Principle of Non-contradiction. (Also called the Principle of Contradiction.)
3. The Principle of Excluded Middle.

These principles are formulated in various ways.

1. *The Principle of Identity.*
   (*a*) A thing is what it is.
   (*b*) Every thing is identical with itself.
   (*c*) A is A.
2. *The Principle of Non-contradiction.*
   (*a*) A thing cannot both be and not be.
   (*b*) A cannot be B and not-B.
   (*c*) The propositions A is B and A is not B cannot both be *true*.
3. *The Principle of Excluded Middle.*
   (*a*) A thing either is or is not.
   (*b*) A is either B or not-B.

(*c*) The propositions A is B and A is not B cannot both be *false*.

What do these principles signify? They seem to be absurdly simple and it looks strange that the entire structure of thought should stand on flimsy foundations like these. It will be better if the student reserves his judgment, till he understands their import.

The Principle of Identity emphasizes the right and need of demanding a definite fixed signification of the terms used in an argument.

Suppose we are arguing with a man about the character of Socrates. In the course of the argument we are told of Socrates melting in the sun. We enquire how it can happen and are informed that by Socrates our friend now means butter. In such circumstances, it is impossible to carry on the argument. The minimum that we have a right to demand is that terms shall be used in a definite sense and in the same sense throughout the argument. Socrates will mean Socrates and nothing else. If we talk of things rather than terms, we can demand, according to this principle, that things possess a stable character. Applying the principle to propositions, we are to understand that each proposition has a definite meaning and that meaning remains the same for all individuals, and for the same individual at all times. Unless this were conceded, reasoning would be impossible.

In formulating the Principles of Non-contradiction and Excluded Middle, we may have in our minds a pair of contradictory terms or contradictory propositions. When it is said that A cannot be B and non-B, the co-presence of two contradictory attributes, B and non-B, in the same subject A, is denied. In Aristotle's formulation of the Principle, reference is made to contradictory propositions. The principle of Non-contradiction denies that both of the propositions—A is B and A is not B—can be simultaneously *true*; the principle of Excluded Middle denies that both can be *false*.

2. CHARACTERISTICS OF THE LAWS OF THOUGHT. Formal or Deductive Logic generally recognizes these three principles as the only ultimate principles of Valid Thougt. They are Axioms or Postulates of knowledge, 'because they are involved in all attempts at interpretting experience, that is, they are the assumptions without which thought cannot even begin the work of reducing to order the chaos of sense impressions. Into the justifications of these postulates logic does not enter. It assumes them because it finds them assumed in every piece of correct thought, and it aims at expressing them as perfectly as possible.'[1]

Thus these principles, being the foundations of all proof, are themselves *incapable of being proved*.

Another characteristic is that they are all *formal*. They do not enlighten us as to the attributes that do or do not belong to a thing; they simply affirm that each thing does possess the attributes that it possesses, and that of two contradictory attributes, one and only one must be found in everything. From these principles, I cannot know whether the knife in your pocket is sharp, but I am confident that it has a determinate nature, that it must be sharp or not sharp, and that it cannot be both.

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[1] Welton and Monahan: *Intermediate Logic*, 13-14

According to some logicians, these laws are also *necessary*, i.e., no one can *consciously* violate them. Many of our reasonings are invalid, but this is due to misunderstanding. No one can accept a contradiction knowing it to be a contradiction. If this be so, the laws of Thought are, like the laws of nature, mere *uniformities*.

All these principles are equally *fundamental*. This means that none of them is derived from another, and that, consequently, the violation of one does not necessarily involve the violation of another.

3. ARISTOTLE'S DICTUM. Besides these principles, Formal Logic sometimes speaks of *Aristotle's Dictum* as a fundamental principle. This runs as follows:—

Whatever is affirmed or denied of a whole class may be affirmed or denied of a part of that class.

This *dictum* and the *canons* on which it is based will be discussed in a future chapter.

4. Material Logic or Logic of Truth formulates an additional fundamental principle, known as the LAW OF SUFFICIENT REASON.

This principle was first formulated by Leibnitz, a German Philosopher of the 17th century. It may be stated as follows:—

Nothing happens without reason why it should be so rather than otherwise.

If I am rowing and the boat moves in a certain direction, there is sufficient reason why it should move in that direction and in no other. Nothing that happens is wholly or partly due to Chance.

CHAPTER III

TERMS AND THEIR DISTINCTIONS

1. **WHAT IS A TERM?** In our common speech we use sentences of various kinds. Grammar has made us familiar with their distinctions. Logic is concerned with one of them only. This is the Indicative Sentence, technically called a PROPOSITION. Logical analysis divides a proposition into three parts—Subject, Copula and Predicate. In the proposition 'man is mortal,' 'man' is Subject, 'is' is Copula and 'mortal' is Predicate. The Copula is the link that connects the Subject and the Predicate and may be affirmative or negative. The connection between the Subject and the Predicate is expressed by saying that the Predicate affirms or denies something of the Subject.

Whatever can form Subject or Predicate of a Proposition is called a TERM (Latin *terminus*=boundary). It is not essential that a term should be a single word. Sometimes a number of words stand for the Subject or the Predicate, and then the whole group is the term. As, 'The present Viceroy of India is popular with all classes.' Here, the Subject and the Predicate are both many-worded or complex. The distinction is not of any logical significance.

A simple Term (a single word) is known as a CATEGOREMATIC word; words that cannot by themselves form

Subject or Predicate of a proposition, but coupled with other words can do it, are called SYNCATEGOREMATIC. In the proposition given above, we find the words *with, the, of*. None of them can by itself be Subject or Predicate in a proposition. These are, therefore, syncategorematic. The words, India, Viceroy, and classes in this sentence, appear as parts of terms, but they may be terms themselves. They are categorematic words or Terms, as they are possible Subjects or Predicates of a Proposition.

2. DISTINCTIONS OF TERMS. Terms can be distinguished from one another in several ways:—

(*a*) *Singular and General.* Lahore is a big city. In this proposition, we have two terms, Lahore and big city. The words 'big city' can stand for an indefinite number of objects, whereas the name Lahore can be applied, in the same sense, to but a single object. 'Lahore' is Singular or individual, whereas 'big city' is General. If Lahore is the name of several cities, it is not applied, in the same sense, to all of them. Sometimes we use a singular term, e.g., Hercules, not to designate any one individual, but to emphasize some characteristics that may be found in several persons. In such a case the name has lost its original character as a proper name. It is not used as a mere mark for identification and should not be regarded as Singular.

Leaving this special case alone, it may be said that *all Proper Names are Singular*. But these names are not the only names that are Singular. Any word or group of words that stands for a single object is a Singular term. The following are some examples:—

(*a*) The youngest son of my cousin.
(*b*) The present King of England.
(*c*) This table.
(*d*) The College, the Principal. (When the students of a College use these words, they are decidedly Singular, being applicable only to one individual. Similarly the word 'Father' used by children in a family may be regarded as Singular.)

When a term is applicable to a *group of similar things* taken all together, it is called a COLLECTIVE TERM. Some logicians treat these terms as a separate class, co-ordinate with Singular and General terms. A little consideration will show, however, that this is a mistake. Both Singular and General terms may be Collective. For instance, 'the present second year class in the college' is Collective and Singular, whereas 'class,' 'library,' 'army,' are Collective and General. The true antithesis is not between General and Collective terms, but between the *Collective* and the *Distributive* use of terms. When a reference is made to a group as a whole, the term is used collectively; when each individual member is referred to, the term is used distributively. The ambiguity of the word 'all' as commonly used will illustrate it. When I say that all the angles of a triangle are equal to two right angles, I refer to the angles *taken together*. When on the other hand, I affirm that all crows are black, I do not mean that all crows must join together to get black. The sentence means that each crow possesses blackness as an attribute. In the first proposition, the subject term is used collectively: in the second, distributively.

As a rule, singular collective terms are not Proper names. There are some cases, however, in which such terms are proper names. The 'Himalyas' and the 'Hebrides' may be mentioned as examples.

It must be borne in mind that a collective term is the name of a *group of similar things*, taken as a whole. A Library consists of books, and so the name is collective. A college consists of rooms, benches, books, tables, apparatus, etc., and so the name is not collective. 'The town of Lahore' is not collective, because Lahore consists of dissimilar parts, as men, streets, open spaces, gardens, etc. If, however, we say that the town of Lahore was out on the Ravi banks on the Baisakhi day, we refer only to the inhabitants of Lahore and here the term is used collectively. Any class name may be used collectively, if we refer to the things denoted by the class name, not distributively but altogether. For instance, 'Schools are better equipped than Colleges'. Here reference is made to Schools and Colleges as groups.

What shall we say of *Material* or *Substantial* names? In 'gold is heavier than water,' it is not implied that the entire stock of gold is heavier than the entire stock of water. Rather, we mean that any part of gold is heavier than an equal volume of water. In such a case, it seems unnatural to regard gold as used collectively. Again, when it is said that 'air envelops the earth on all sides,' obviously reference is made to the entire atmospheric ocean. Here air is used collectively. It is clear, however, that substances like gold, water and air are not divisible into distinct individuals as a class or a library is.

(*b*) *Abstract and Concrete*. Another distinction between terms is that of Abstract and Concrete. A concrete Term is the name of a thing considered as an actual or a possible subject of attributes. An abstract Term is the name of an attribute or a group of attributes. 'Table' is concrete, 'smoothness' is abstract; 'Man' is concrete, 'humanity' is abstract.

Many terms that are concrete cannot be used as abstract. There are some, however, that can be used in both ways. We have defined the concrete term as the name of something that can be subject of attributes. Now sometimes it so happens that attributes can be predicated of other attributes. I speak of the warmth of my bed. Here warmth is obviously abstract. Then I speak of the agreeableness of this warmth. Here agreeableness is abstract and warmth is, with reference to this, concrete. Take the term 'colour,' signifying colouredness (e.g., of a rose). It is abstract. But it can have various forms—red, blue, green. We can speak of colours, and should, therefore, regard it as concrete. Taking the word 'colour' in the sense of colouredness, we can speak of its brightness or saturation. Hence, brightness or saturation is abstract and colour is concrete.

Can the distinction of singular and general be applied to abstract terms? Opinion about this point is not unanimous. Mill thinks that abstract terms can be general, as colour, size, shape, etc., because there are so many forms of them. Jevons thinks that when various forms of the same so-called attributes are referred to, the term is really a concrete term. All abstract terms, according to this view, are singular.

Another point, to be settled is the position of Attributive terms. Are they to be treated as concrete or abstract? Many logicians are of opinion that *attributives should be treated as concrete*. 'My book is new.' Here 'new' stands for a new thing or a new book. This seems to be the correct view, when the adjective appears as predicate in a proposition. But sometimes the adjective appears as the subject; as, black is a sign of mourning. Here black stands for blackness and should be regarded as abstract. When the adjective is coupled with a substantive to form subject or predicate in a proposition, we should consider the entire combination, and its character is determined by the substantive part. As, 'great strength' is abstract, 'great king' is concrete.

(*c*) *Positive and Negative*. A positive term is a name that implies the *presence* of a definite attribute or attributes. A negative term is a name that implies the *absence* of the attribute or attributes implied by the corresponding positive term. As, white, not-white; popular, unpopular. The distinction also applies to Proper names; as Plato and non-Plato. The negatives of some Positive names are found ready-made in language, but with a vast majority of terms the case is different. We can, however, in every one of these cases form a negative.

The positive name is indicative of definite attributes or applies to a definite individual or individuals. The negative name, on the other hand, is comparatively indefinite. Each term can be used as a means of dividing the whole universe into two parts. The term 'horse' applies to everything positively or negatively, i.e., everything either is or is not a horse. Similarly everything either is or is not triangular. This is the view of Mill and Jevons. According to others, (e.g., Bain and De Morgan) it is absurd to talk of my soul or your character as non-triangular. The term non-triangular can apply only to figured things and the name non-horse to animals. There is no sense in talking of Thackeray's style or the Scope of Logic as non-red. According to this view, the positive and the negative term exhaust not the entire Universe, but only the universe to which reference is made, technically called *the Universe of Discourse*.

The negative is often formed by adding a prefix like un, in, im, mis, non, etc., to a positive term. Sometimes, however, no such prefix is needed; 'darkness' is the negative of 'light.' And it is not necessary that the presence of such a prefix should indicate the absence of an attribute. 'Invaluable' means much the same as 'very valuable'; 'inestimable' is likewise positive.

The relation between Positive and Negative terms is that of *Contradiction*. Contradictory terms are so related that they are mutually exclusive; and, between themselves, exhaust the entire Universe to which reference is made. We have another kind of opposition between terms 'when they denote things which can be regarded as standing at opposite ends of some definite scale in the Universe to which reference is made; e.g., *first* and *last*, *black* and *white*, *wise* and *foolish*, *pleasant* and *unpleasant*.' (Keynes.) Contraries admit of a mean between them, whereas contradictories do not. Incompatibility or opposition short of contrariety is sometimes called *Repugnance*. Taking 'white,' we may say that 'not-white' is its contradictory, 'black' is its contrary and 'red' is repugnant to it.

'A Privative Term,' says Mill, 'is the name of something which has once had a particular attribute, or for some other reason might have been expected to have it, but which has it not.' Thus it combines the character of a positive and a negative term. Such a term is 'blind,' which applied to a man indicates either that he could once see, or that, judging from the very large number of men that can see, we should have expected this man also to be able to see. Deaf, dumb, empty are other instances. The word *privative* indicates that the substance is *deprived* of some attribute. The distinction is not of any logical importance.

(*d*) *Relative and Absolute*. Some terms besides denoting an object involve reference to another object without which reference their own meaning cannot be comprehended. These are called Relative terms. For instance, when I use the word 'father,' I am making a reference to 'son'; otherwise the signification is not clear. Both the terms taken together form a pair of *Correlatives*. Other instances are 'partner,' 'equal,' 'teacher,' 'king,' 'wife.' Non-relative terms are known as Absolute. In a way all things are connected with one another, and, consequently, their names cannot be absolutely unrelated. The term 'man' may suggest boy, woman, officer, and may, therefore, be regarded as Relative. 'Table' suggests 'non-table,' and similarly every other positive term suggests its negative. This, however, does not justify our rejecting the distinction altogether. The relation between 'father' and 'son' is of a peculiar and striking kind. We cannot think of the one without the other; whereas the same cannot be said of table and non-table. How many times when we speak of the table, does the thought of non-table actually occur to us?

The distinction of Relative and Absolute does not apply to proper names.

(*e*) *Connotative and Non-Connotative.* When a man asks me what a watch is, I may show him the watch in my pocket or mention some attributes that each watch possesses. The various things known as watches are *denoted* by the term watch; the attributes that are necessarily present in a thing to make it a watch are *connoted* by the term. The watch is said to have two kinds of meaning—Connotative and Denotative meaning. 'By *connotation* (of a term) we mean attributes on account of which any individual is placed in the class and called by the name; by its *denotation* we mean the individuals which possess these attributes, and which are therefore placed in the class and called by the name."

(Keynes.) In the next chapter we shall discuss the relation between these two kinds of meaning that terms have. Here, we shall only enquire if all terms have a meaning in *connotation* or there are some non-connotative terms also.

If we take the division of terms into concrete and abstract (all terms are *either* concrete *or* abstract), our question may be split into two parts—

(*i*) Have abstract terms a meaning in connotation?

(*ii*) Have concrete terms a meaning in connotation?

Mill answers these questions in the following manner:—

'A non-connotative term is one which signifies a subject only, or an attribute only. A connotative term is one which denotes a subject, and implies an attribute. By a subject is here meant anything which possesses attributes. Thus 'John,' or 'London,' or 'England,' are names which signify a subject only. 'Whiteness,' 'length,' 'virtue,' signify an attribute only. None of these names, therefore, are connotative. But 'white,' 'long,' 'virtuous,' are connotative. The word 'white' denotes all white things as snow, paper, the foam of the sea, etc., and implies or, as it was termed by the schoolmen, *connotes* the attribute *whiteness*. All concrete general names are connotative. The word 'man' for example, denotes Peter, James, John, and an indefinite number of other individuals, of whom, taken as a class, it is the name. But it is applied to them because they possess, and to signify that they possess, certain attributes.'

And again:—

'Even abstract names, though the names only of attributes, may in some instances be justly considered as connotative; for attributes themselves may have attributes ascribed to them; and a word which denotes attributes may connote an attribute of these attributes.'

According to Mill, then, the following classes of terms are connotative—

(1) All concrete general names.

(2) Some singular names. (The present prime minister of England; the youngest son of my cousin.)

(3) Some abstract terms. (Fault, for it connotes hurtfulness.)

Other logicians differ with Mill on two points. Some maintain that *proper names* also have connotation; others hold that *no abstract term has a connotation.* We shall briefly consider both these points.

'If the name' says Bosanquet, 'has no signification for what reason or by what means, is it attached to a person or place? You may say that it is only a conventional mark. But a mark which has power to select from all subjects in the world, and bring to our minds, a particular absent object, is surely a significant mark.'[1]

It is true that a proper name possesses a signification, but it does so only for a limited circle of people, who *otherwise know about the object bearing the name.* The connotation of a term does not stand for the attributes that I or you may happen to know as belonging to the object, bearing that name, but for the attributes that the name will imply to any one who understands the language. The name Karm Chand may mean, to the friends and relatives of the man, a tall stature, a sweet voice and attractive features; but the knowledge of these attributes of Karm Chand is not acquired from his name. It has been said that all names originally were significant. In India, most of the names even now are. But they do not generally imply the actual attributes of the bearers of those names. Names are given to infants when not much about their peculiar characteristics can be known. Ram Bhagat need not be of devotional temper, and Danishmand may be anything but a model of common sense. Some names like Amritsarya Mal and Chet Ram may indicate where and when a man was born. In the first place, the names mention merely accidental circumstances about the individuals and these have no right to be treated as a part of their connotation. Secondly, who can prevent a boy born at Benares from being named Lahori Ram? It may be said that many proper names do signify something definite and important. Ganga Ram signifies that the bearer of the name is (*a*) a human being, (*b*) of male sex, (*c*) a Hindu by birth and one probably even now. This knowledge also, we may say, is not certain. Ganga Ram may be the name of an inanimate thing or a pet bird. Ships, stars, cricket bats are named after human beings. What shall we say about the names like Miss Jones and Mrs. Jones? Do not both the names indicate the sex of their bearers? Again, do they not indicate whether the bearer of the name is married?

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[1] Essentials, 91

Yes, they do indicate these things, but, strictly speaking, *Miss* and *Mrs* are titles and not parts of names.

About the first point, then, we agree with Mill in holding that *Proper names have no connotation.*

As regards Abstract terms, they do not imply any attributes, but are the names of attributes. This is true of all abstract terms. If by connotation of a term we mean the attributes that the term implies as belonging to the bearer of the name, abstract terms can have no connotation.

"The only example that Mill gives of a connotative abstract is *fault,* which he says is a name common to many attributes, and which connotes hurtfulness, an attribute of those various attributes. But it may be doubted whether 'fault' is really abstract at all. The true abstract appears to be *faultiness.* 'Fault' is at any rate not generally used as the name of a quality considered apart from the individuals possessing it; the name is rather that of some particular act or habit, as when we talk of committing a fault, or of excusing fault and thereby making it worse."[1]

Some logicians distinguish terms as *univocal* and *equivocal.* A univocal term has only one meaning, is unambiguous. An equivocal term is ambiguous and has more meanings than one. 'Inkpot' is univocal; 'bat' is equivocal. The distinction is of no logical significance. In fact, it is questionable whether we can with any propriety treat 'bat' as a single term. We have here two terms which happen to have the same spelling and sound.

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[1] Keynes: *Formal Logic,* 37

When we are asked to mention the logical characteristics of any term, we are to say whether the term in question is:—

(*i*) Singular or general:
  Used Distributively or Collectively.
(*ii*) Abstract or Concrete.
(*iii*) Positive or Negative.
(*iv*) Relative or Absolute.
(*v*) Connotative or Non-Connotative.

CHAPTER IV

CONNOTATION AND DENOTATION OF TERMS

1. **Terminology.** In the last chapter, we briefly indicated that most terms have two kinds of meaning—meaning in Connotation and in Denotation. 'The denotation of a name consists of the things *to which* it *ap*plies, the connotation consists of the properties which it *im*plies. The denotation is made up of individuals and the connotation of attributes' (Bosanquet). It will be the business of this chapter to examine these two kinds of meaning in some detail and to discuss the relation that exists between them.

But before we do this, we may note that several pairs of terms have been proposed to mark the distinction of meaning to which reference has been made.

They are:—

Connotation and Denotation.
Intension and Extension.
Content and Extent.
Comprehension and Area.

The terms in general use are Connotation or Intension and Denotation or Extension, and most logicians use them interchangeably. Some logicians, however, attach different meanings to them. Boyce Gibson, for instance, uses the word Intension in the sense of Connotation *plus* Denotation. Then, it has been suggested that the Denotation of a term should signify the *individuals* to which the name applies, and Extension should signify the *sub-classes* to all of which the term is applicable. Thus Karm Chand, Inayat and Jones form part of the Denotation of man; and Aryan, Semite, etc., are part of its Extension; 'College' denotes D. A. V., Government, Islamia and others; whereas denominational and undenominational, or first grade and second grade colleges constitute its Extension.

In this book we shall disregard these distinctions and use the words interchangeably.

2. WHAT IS MEANT BY DENOTATION AND CONNOTATION? We have said above that the denotation of a name consists of the things to which it applies. What are we to understand by *things?* For purposes of Logic, a thing may be defined as an object of thought. This is a very wide meaning and covers the case of things that have no existence in the real world. An ocean of gold does not exist, but I can think of it. A triangular circle does not exist; I cannot imagine what it would be like if it existed, but, notwithstanding this, I can think about it. I attach a definite meaning to the word; otherwise, I should not be able to say of a particular figure presented to me that it is *not* a triangular circle. Shall we say that such terms have a Denotation? Some logicians define 'thing' as an object of thought that possesses real existence and a character. If we accept this view, we should refuse to accept as part of the Denotation of man, the individuals of whom we dream or whom we seem to see in illu-

sions or hallucinations. The characters in novels and dramas also must be treated likewise. Still we shall have to settle about men who *were* existent or *will be* existent, but *are not*. Do Socrates, the philosopher of ancient Athens, and a future Newton form part of the Denotation of 'man'? Strictly speaking, the term 'man' does not apply to them. They *are not* men; one was and the other may be. The Denotation of a name consists of *things that do really exist now* and bear that name.

What are we to understand by the Connotation of a term? A name suggests different ideas to different individuals, as also to the same individual at different times. Again, the number of the attributes that a thing possesses (or that are found common among all members of a class) may be very large. And we may know but an insignificant fraction of the totality of attributes possessed by a thing or a class of things. For which of these sets of attributes does the term Connotation stand?

The following answers have been given:—

(*a*) The connotation of a term means the set of attributes which the name suggests to those that use the name.

(*b*) The connotation of a term means the totality of *known* attributes that the thing (or the class) bearing the name possesses.

(*c*) The connotation of a term means the totality of attributes, *known or unknown*, which the thing (or the class) bearing the name possesses.

The first view is obviously unsatisfactory, because it makes connotation of a term purely subjective and altogether indefinite. The second and the third make the connotation of a term much too complicated; the third is the formulation of an Ideal rather than the statement of a psychological fact. According to this view, perhaps there is not one term of which we know the connotation. The bounds of knowledge widen with every advance in knowledge, just as the child's horizon ever recedes from him. Perfect knowledge of a thing (the whole truth about it), if realisable at all, can be realized only in the distant future.

We may then reject these views about the meaning of connotation, and use the term to signify only *those attributes on account of which we apply the name to a thing or a class, and in the absence of any of which we should not apply it.*

3. THE RELATION BETWEEN DENOTATION AND CONNOTATION. The relation between these two kinds of meaning is commonly expressed by saying that *the Denotation and the Connotation of a term vary inversely.* This mathematical language is inappropriate. If we consider a single term 'College,' the establishment of a new College or the closing of an old one will affect the Denotation, but it will not affect the Connotation of the term. Similarly, the Connotation of the term 'man' does not need revision at the birth or death of every single individual. Secondly, the Connotation of a term may be enriched without affecting the Denotation. We may come to know of an important attribute belonging to

all members of a class and thenceforward accept it as an essential mark of the class, but the number of the members of the class will not be affected by this circumstance. The principle of inverse variation of Denotation and Connotation applies not to single terms but to terms in a classification, and in one series of subordination in it. We compare two terms as regards Denotation and Connotation, and find that the term that is richer in Connotation is poorer in Denotation and *vice versa*. It is obvious that we cannot thus compare any two terms. It is absurd thus to compare book and uncle. The terms must be related as occurring in a classification and specially in one series of subordination. One of them should be included in the other. When we get a series of terms so related, the application of the Law becomes obvious. Let us have an example:—

Indian
|
Educated Indian
|
Indian Graduate
|
Indian Graduate in Medicine
|
Indian Graduate in Medicine practising the art of healing

Here we see that the number of Indians is larger than the number of educated Indians, but each of the latter besides being an Indian possesses the attribute of being educated. The number of educated Indians is larger than the number of Indian graduates, but these latter besides being merely literate have successfully gone through a course for the Degree. And so on to the end.

The principle can be formulated thus: *In a series of terms arranged as subordinate and super-ordinate one to another, as denotation increases, connotation decreases; and vice versa.*

But even in this form, there is a possible misconception against which we must guard ourselves. We are not to understand that the connotation and denotation vary inversely, in the strict mathematical sense. If the number of Indian graduates is 2 per cent of educated Indians, we are not to infer that the attributes possessed by an Indian graduate are 50 times as many as an educated Indian possesses.

It may be noted here that these two meanings are not opposed; rather they are complementary each of the other. In fact, when we want to develop the meaning of a concept, we combine both these meanings. In defining 'Term,' we say that 'a Term is a word or a group of words capable of standing as subject or predicate in a proposition; as, horse, Socrates.' The definition states the connotation, but we generally supplement it by referring to a part of the denotation. Of the two functions—implying attributes and referring to individuals—now the one and again the other is the more prominent. That depends upon the nature of the terms and on circumstances.

4. WHICH OF THESE TWO MEANINGS IS PRIMARY? Taking the term 'man' as an example, our question is this—Do we start with a set of attributes and proceed to

find the individuals that possess these attributes, or do we first start with a group of individuals accepted to be men and proceed to discover their fundamental common points? Which of these meanings determines the other? Obviously, we cannot accept an individual as a man, except on the ground of some attributes that he possesses in common with some other individuals. Logically, connotation is the primary meaning and determines the denotation. It is, however, much easier to think in denotation. Most men when they think of a table or a stool or a room, have some specific objects in mind and do not take the trouble of precisely defining these terms. Many will find the definition of such familiar concepts to be a difficult task. It is a *psychological* fact that in case of most terms the denotation is more prominent in our minds; yet, *logically, the connotation is primary and determines the denotation.*

CHAPTER V

PREDICABLES AND CATEGORIES

1. **Aristotle's Scheme of the Predicables.** We have seen that each proposition consists of two terms (subject and predicate), connected by the copula. What kind of relation can exist between these two terms? In what relations can the predicate stand to the subject?

According to Aristotle, the predicate may coincide with the subject in denotation and connotation, may agree in one and differ in the other, or may differ in both. If we take 'man' as a subject, what can we predicate of it? If the predicate is 'rational animal,' the two terms agree in connotation and denotation. The predicate is the *Definition* of the subject. If the predicate is a 'cooking animal,' the denotation of both the terms is the same, but the connotation is different. The capacity of cooking follows from the rational nature of man, but is not included in the connotation of the term 'man.' We do not necessarily refer to this in order to define 'man.' This predicate is called *Proprium*. If the predicate is 'animal,' the two terms differ in denotation, but partially agree in connotation. This predicate is known as *Genus*. If the predicate is 'red-haired' the terms differ in denotation partially and wholly in connotation. This predicate is known as *Accident*.

Whatever can stand in the relation of predicate to a subject is called *Predicable*. According to Aristotle's scheme, there are four Predicables:—

(*i*) Definition.
(*ii*) Genus.
(*iii*) Proprium.
(*iv*) Accident.

2. PORPHYRY'S SCHEME OF THE PREDICABLES. The Scheme of Predicables connected with the name of Porphyry (234-304 A.D.) has practically superseded Aristotle's Scheme. Porphyry omits *Definition* and puts in *Differentia* and *Species*.

He thus gives us five predicables, as follows:—

(*i*) Genus.
(*ii*) Species.
(*iii*) Differentia.
(*iv*) Proprium.
(*v*) Accident.

These are known as *Heads of Predicables* or *Porphyry's Words*.

GENUS AND SPECIES. When two classes are so related that one includes the other, the larger class is called the Genus, and the smaller class, the Species. 'Rectilinear figure' includes 'triangle.' 'Triangle' is the species of 'rectilinear figure.' The same term may be Genus in one connection and Species in another. Thus we may divide 'Figure' as follows[1]:—

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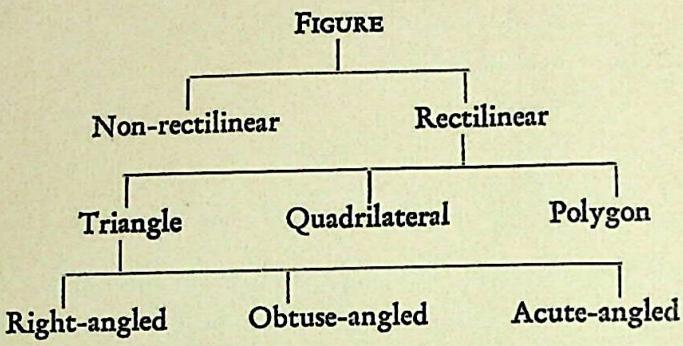
[1] Here we anticipate; but the division given should be quite intelligible.



'Rectilinear figure' is genus of 'triangle,' but species of 'figure.' The highest genus in a process of Division is called the Summum Genus. The genus under which a species falls immediately is called its Proximate Genus. The lowest species are called the Infima Species. Species that fall under the same genus in a single step of the Division process are called Cognate Species. The term Cognate Genus is applied to all the classes under which a species falls.

A little consideration will show that though from the point of view of Denotation, the Genus includes the Species, yet from the standpoint of Connotation, the Species includes the Genus. We have already discussed this point in considering the relation between two kinds of meaning the terms have. In fact, the principle of the inverse variation of connotation and denotation can be expressed as follows:—

Denotatively considered, the Genus includes the Species; connotatively considered, the Species includes the Genus.

DIFFERENTIA. Confining our attention to the connotative meaning of terms, we may say that each Species has some attribute (or attributes) in excess of the connotation of the Genus, and this attribute it is that gives it its specific character. This specific mark of the Species is called the Differentia. Take 'triangle.' It is a rectilinear figure, but which one of the whole class of such figures? Unless there is something that enables us to differentiate it from the square and the pentagon, our knowledge of it cannot be clear. If we add *three-sidedness* to the notion of rectilinear figure, we have a particular class (triangles). Three-sidedness is then the differentia of 'triangle.' Having one of its angles equal to 90° is the differentia of right-angled triangle.

Differentia=(Species—Genus).

Proprium. A triangle is a three-sided rectilinear figure. The student who has read elementary geometry must be familiar with a large number of propositions that can truly be affirmed of all triangles. In every triangle the internal angles are equal to two right angles. In every triangle two sides are greater than the third. These propositions follow from the very nature of a triangle, but we do not mention them when defining a triangle. If we undertook to state all propositions of this type, our task would be well-nigh impossible. Such propositions mention attributes which are called Propria or Properties. *Properties are the attributes which are found in each member of the class bearing the name, and, though necessarily following from the connotation, are not a part of it.*

Properties are distinguished as Generic and Specific. A property is generic if it follows from that part of the connotation of the name which is derived from the genus: it is specific, if it flows from the differentia. 'Man is a rational animal.' 'Animal' is the genus of 'man' and rationality is the differentia. The mortality of man follows from his animal nature, the capacity of using language or studying logic from his rationality. Mortality is a generic, and capacity of using language, a specific property of man.

Is the distinction between Differentia and Property fundamental? The Differentia is an attribute that we accept as essential to the nature of the object. Are the Properties non-essential? Really the properties of an object are as essential as the attributes that we designate as the connotation of the term naming the object. None of them can be eliminated from the object without fundamentally altering its nature. Consider, for an example, the term 'triangle.' 'A triangle is a three-sided rectilinear figure.' This proposition states the essence of a triangle. 'A triangle has any two sides greater than the third.' 'The angles of a triangle are equal to two right angles.' These propositions state properties of a triangle. But no figure can be a triangle unless it has these attributes. So far as their indispensableness is concerned, properties and essential attributes stand on the same level. The properties do not depend upon the so-called essence: they are of the very nature of the object as much as the essence is. But for practical purposes there is a difference between the two kinds of attributes. 'The essence is that with which we must start, in order to have the figure before us, and say anything about it, while the properties are what we can demonstrate' (Joseph: 99). No one can begin to deal with a triangle without noticing that it is a rectilinear figure and has three sides; the properties that we have mentioned above are not equally obvious. To many they are not known; and even those who know them may not be thinking of them, when they see a triangle.

ACCIDENT. Every object possesses some attributes which are neither the connotation of the name, nor necessarily follow from it. These attributes happen to be present in the thing, but need not have been there. The essential nature of the thing would remain unchanged even without them. Such attributes are known as Accidents. They are of two kinds—*Inseparable and Separable.* An Inseparable Accident is an attribute that belongs to a thing always and cannot be changed. Such an attribute is the time of a man's birth, or his parentage. A Separable Accident can be changed; as a man's vocation, religion, size and colour of the hair. In case of classes, an Inseparable Accident is an attribute that is found in all the members of the class; as, two-earedness in men. A Separable Accident, in case of classes, is an attribute that belongs to some members of the class only; as, greenness in parrots, stammering in men.

Of the five Predicables, the first two—Genus and Species—stand for groups of objects; the remaining three, for attributes of objects. As we have seen, the Differentia is the attribute with which we start; the properties are the attributes which are necessarily bound up with the Differentia. Besides these two kinds of attributes, every object has a number of other attributes of a miscellaneous character. All these are known as Accidents. These are the peculiar features of the object and do not belong to it as a member of a certain class.

If all the members of a class possess an attribute which is accepted neither as the class essence nor necessarily bound up therewith, we call it an Inseparable Accident. But how do we know that this too is not a property? Obviously, we cannot be absolutely certain about it. All we can say is that so far we have not been able to find a necessary connection between this attribute and the essence of the class. And in the present state of our knowledge or ignorance, we are prepared to admit that instances that are yet unobserved may not show the presence of the attribute in question. The distinction between Property and Inseparable Accident is founded upon our ignorance of a necessary connection between a class essence and certain other attributes found in all members of the class.

The following examples will show how the predicate can be related to the subject:—

1. A triangle is a rectilinear figure. (Genus)
2. Some rectilinear figures are equilateral triangles. (Species)
3. A triangle is enclosed by three straight lines. (Differentia)
4. A triangle has two sides greater than the third. (Property)

5. Triangles are included in the Geometry Syllabus prescribed for the Matriculation Examination. (Accident)

The Words of Porphyry do not give an exhaustive division or enumeration of the various types of Predicates. They were not intended for that purpose. As we shall see a little later, the relations in which the Predicate can stand to the subject are many. Porphyry's scheme refers to only two of them—the predicate may be a class including the subject or included in it, or it may be an attribute qualifying the subject.

3. **Categories.** In ordinary language, the word 'category' means class or group. We say, for instance, 'mind and body belong to different categories.' In technical use, with which alone we are concerned here, categories are *summa genera* or general classes into which Being as such may be divided. Aristotle sometimes speaks of two categories—substance and quality—but the complete list as given by him comprises the following *Ten Categories*:

Substance, Quantity, Quality, Relation, Place, Time, Position, Possession, Action, Passion (*Suffering*).

Let us consider Ramlal. What can we say of him? He is—

A man (Substance),
Six feet high (Quantity),
Very clever (Quality),
At the top in his profession (Relation),
Now (Time),

Arguing a case (Action),
In the High Court (Place),
Standing erect (Position),
With a file in his hand (Possession),
And interrupted by his opponent (Passion).

CHAPTER VI

DEFINITION

1. **What is Definition?** The main business of logic is to formulate the principles which enable us to distinguish between valid and invalid reasoning. Our science is chiefly concerned with arguments. Arguments, however, ultimately consist of terms, and, thus, a study of terms becomes a legitimate, nay an essential, part of the subject. In connection with terms, our first concern is to fix their meaning. Unless a definite and precise meaning attaches to the terms that we use in our arguments, we may have enough of wrangling, but cannot have much of valid reasoning. The concepts with which we work must be clear and distinct. To secure clear concepts is the aim of logical definition.

When a child asks me—'what is an elephant?', I may just point to an elephant and say, 'An elephant is a creature of this type.' This may satisfy the child and he may be enabled to recognise the elephant and distinguish it from some other animals. Suppose, however, that no elephant is near at hand. I shall proceed to describe some prominent features of the animal, and, appealing to his imagination and memory, shall enable him to construct some rough image of the elephant. I shall talk of its massive body, its column-like legs, its huge ears, its tough skin, etc. When a zoologist begins to define an elephant, such an enumeration of external features is quite out of place. He aims at telling us what is essential in the structure of the elephant. The characteristics that he mentions are quite different from the external marks that may suffice to identify the animal for practical purposes. He is not satisfied with the so-called *Definition by Type*, nor with the *Enumerative Description*, but attempts to give us a *Logical Definition* of the class—elephant. Using technical language with which we are already familiar, we may say that he seeks to give us the connotation of the term elephant, rather than mention some accidents or properties of the class. He appeals to thought rather than to imagination, memory or perception. *To define a term is to analyse it in connotation.*

'Prove every Proposition and define every Term.' This advice of Pascal is excellent; but, alas! human life is limited, and in that limited period too one has so much else to do. However, it is desirable that we keep it in our mind as an ideal. We should take no statements for granted, unless there is some good reason for doing so, and should try to define all terms that are obscure. We may have to define all kinds of terms. First, we require to define technical terms used in the various Sciences and in Law. Again, we may have to define what are called Natural Kinds, the various types of plants and animals. The theory of Evolution has shown that the distinctions of the kinds are not absolutely rigid and fixed, and that living things imperceptibly pass into each other. Consequently, the main business of Botany and Zoology is not to define the various kinds, but to classify objects and to study the laws of their growth. Thirdly, there are the objects produced by human skill, as, bicycle, watch, chair. Fourthly, there are mental processes (e.g. perception, emotion), moral virtues (e.g., justice, courage), and social institutions (e.g., monarchy, marriage). And there are so many other kinds of terms that need being defined. Here we can only indicate the general principles to be kept in mind in attempting a definition.

2. THE DISCOVERY OF THE DEFINITION. We may have to *discover* the definition or simply to *express* it in precise language. The *discovery* of the definition is by far the more difficult task. In fact an important function of physical and mental sciences is to furnish us with correct definitions of the concepts that we generally employ. The great merit of Socrates was to emphasize the importance of definitions in the realm of morals. He confined his work to this one sphere, but the method that he employed is applicable in every science. It is known as the Inductive Method. You have to take several individuals bearing a common name and to see in what they all agree. You have also to take individuals of a contrasted class and to see in what respects the members of the first class differ from those of the second class. The first step in the process gives points that are *common* to all members of the class; the second step gives the points that are *peculiar* to the class.

In discovering the definition of a term, our effort often is to find the proximate genus of the class and add to it the differentia of the class. A definition of this kind is known as definition per genus et differentiam.

3. DEFINITION PER GENUS ET DIFFERENTIAM. Let us suppose that we have to define Poetry. What is its proximate genus? Poetry is one of the fine arts. But which one of them is it? Painting appeals to the eye and employs colours, light and shades as its instruments. Dancing employs movement and sound as its instruments. The instrument that Poetry employs is rhythmical language. This is the differentia of Poetry, which can be defined as a *fine art employing rhythmical language as its instrument*. What is a Noun? The genus is a name; the differentia, of a person, place or thing. A noun is the name of a person, place or thing. Similarly a triangle is a plane rectilinear figure enclosed by three straight lines. A definition of this kind is perhaps the best definition of a term than can be given, but it is not quite so easy to give as it may seem to be.

4. THE EXPRESSION OF THE DEFINITION. Supposing we have discovered the connotation of a term, our next business is to express it in a proper form. The *Rules of Definition* given in the text-books generally relate to the *expression* of the Definition. They may be enunciated as follows:—

(1) The definition must state the most essential features of the members of the class to which the term is applied.

(2) The definition must be convertible with the term defined: it should be neither too wide, nor too narrow.

(3) The definition should not be obscure; it should be clearer than the term defined.

(4) The definition should not use, explicitly or implicitly, the term to be defined.

(5) The definition should not be negative, if it can be positive.

We shall briefly comment on these rules.

The first two rules are practically the definition of a definition. The first rule distinguishes between a logical definition and a description, and further suggests that we must limit ourselves to the statement of the most essential features. If you define 'man' by mentioning the number of his teeth, the arrangement of his ribs, etc., you are only describing him. The most essential features of a man are his rationality and animality, and the definition of 'man' needs no more than a statement of these. Man is a rational animal. An equilateral triangle is a triangle of which all sides *and angles* are equal. However, the statement about the equality of angles is superfluous; it follows from the equality of the sides. Euclid's definition of a square (a plane rectilinear quadrilateral, having all sides equal and all angles right angles) is open to objection on the same ground. If we have a quadrilateral with four equal sides, which has one of its angles a right angle, the other three angles are necessarily right angles.

The second rule demands that if the term defined becomes the predicate, and the definition the subject, the new proposition should be as true as the original one. A noun is the name of a person, place, or thing; and we can say—the name of a person, place, or thing is a noun. If a man defines a triangle as a plane rectilinear figure, the faultiness of the definition becomes obvious when we change the proposition into 'A plane rectilinear figure is a triangle.'

The object of Definition is to attain to clearness of thought, and, therefore, a definition that it expressed in obscure language defeats the very purpose for which it is formulated. Obscurity may be due to the use of difficult or ambiguous words or metaphorical language. The use of difficult language for purposes of definition leads to defining *ignotum per ignotius*, the unknown by the more unknown. Johnson's definition of a net as 'a reticulated fabric decussated at regular intervals,' is a well-known instance of this. Metaphorical language may sometimes give a luminous description, but a description, however luminous, is not a definition.

Some instances of metaphorical descriptions, which may pass for definitions, are the following:—Bread is the staff of life; the lion is the king of beasts; the camel is the ship of the desert; Logic is medicine of the mind; man is the lord of creation.

A definition that uses the term to be defined is known as circular definition and possesses no value; as, 'man is a human being'; 'a king is a person using regal powers.' This rule also forbids the use of correlative terms; as, 'a cause is that which produces the effect.' Is the definition of an equilateral triangle as a triangle having all sides equal, defective?

A negative definition tells us not what a thing is, but what it is not. Such a definition does give us some information, but that is quite vague and indefinite. 'A liquid is something that is neither solid nor gaseous.' 'Matter is that which is not mind.' These propositions do not furnish any positive information.

A negative definition is not only allowable, but also preferable to the positive definition, when the term defined is negative. 'A blind man is one who cannot see.' 'A foreigner is one who does not belong to our country.'

5. KINDS OF DEFINITION. Definitions are distinguished as Nominal and Real. A nominal definition analyses the meaning of a term; a real definition seeks to characterise some part of reality. The real definition implies the real existence of the thing defined, the nominal definition does not. A triangular circle may be defined, but the definition will be nominal. A definition is Genetic when it describes how the thing defined is generated. As, water is the liquid produced by the combination of Hydrogen and Oxygen in a definite proportion; a cylinder is a figure generated by the revolution of a line round another line and parallel to it.

We may also distinguish between definitions of mathematics and those of natural sciences. In mathematics, we start with the definitions and draw consequences from them, taken together with some axioms. In natural sciences, we do not start with definitions, but aim at finding them. Aristotle said that definitions are the beginning and the end of knowledge. In mathematics, they are the beginning; in natural sciences, they are the end.

6. LIMITS OF DEFINITION. Definition is the *analysis* of a term in connotation. Terms that have no connotation are indefinable. Such are proper names. We can describe individuals, e.g., Napoleon, but we cannot define them. Similarly simple abstract terms are indefinable. No one who has not himself been pleased can be informed of what pleasure is, and to a man born blind we cannot communicate the meaning of redness. Definition is the analysing of a complex concept into its constituents. Some of these constituents may themselves be complex and may be further analysed. Ultimately we must come to a point beyond which our analysis cannot go. This limit is reached when our constituents are really simple.

CHAPTER VII

LOGICAL DIVISION

1. **What is Logical Division?** To divide means to break into parts, to analyse. Any analysis, however, is not Division in the logical sense of the word. Logical Division is a definite process which must be distinguished from some other processes with which it is liable to be confounded. A proposition is analysed into subject, copula and predicate; or into the parts of speech that compose it. A tree is divided into roots, stem, branches, leaves and fruit. A man is divided into head, trunk, legs, etc. These are instances of *Physical Division* or *Partition*. Here an individual object is divided into its component parts. Again, one may merely enumerate the attributes that belong to a thing. This is *Metaphysical Division* of the thing. We may say about a triangle that it is a plane rectilinear figure, it is enclosed by three sides, it has its internal angles equal to two right angles and so on. When I am asked what a continent is, I may simply name all the continents. This is *Enumeration*. *Logical Division* differs from all these processes; it is the analysis of a Genus into its component Species. It differs from Physical Division inasmuch as what we have to divide here is not an individual thing but a class. It differs from Enumeration inasmuch as the dividing members are not individuals but classes. It differs from Metaphysical Division inasmuch as it is an analysis in Extension and not in Intension.

The attributes into which Metaphysical Division analyses a thing cannot exist apart from each other. They are distinguishable, but not separable. The softness and the colour of the rose cannot be separated as the parts of an individual rose or the species of the genus rose can be separated from one another. 'In Logical Division, the whole which is divided can be predicated of its parts—*animal*, e.g., *of man, ox*, etc.; in Metaphysical Division, the parts can be predicated of the whole—e.g.,—whiteness, sweetness, etc., can each be predicated of sugar, in saying that sugar is white, is sweet, etc.; in Physical Division, the parts can neither be predicated of the whole, nor the whole of the parts—we cannot either say that a leaf or stem is a plant, or that a plant is a leaf or stem.'[1]

2. **Logical Division and Definition.** In studying the Logic of terms, our chief concern is to know how we can attach precise meaning to the terms that we use. As we have seen, Definition aims at securing this precision of meaning. Division supplements Definition in the service of this same end. Definition tells us something about the essential marks of a class; Division tells us in what different forms this class appears. Definition tells us that a triangle is a plane rectilinear figure enclosed by three sides; Division tells us how these sides may be related to one another; e.g., they may be all equal, two of them may be equal or all may be unequal. Division thus makes our concept of the triangle more determinate.

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[1] Joseph: *Introduction to Logic*, 133

'As Definition refers to the comprehension of a notion, and serves to make the meaning clear, so Division refers to the extension of a notion, and serves to make our meaning distinct. A notion is clear when I can distinguish it as a whole from other notions; a notion is distinct when I can enumerate or specify the sub-notions or classes contained under it. Division draws out these.'[1]

Division is allied to Definition not only in regard to its *function*, but also in its *origin*. In the last chapter, we found that the most satisfactory way of defining a term is to state its *genus* and *differentia*. A definition of this type implies that we have already divided the genus into two component species. When I define man as a rational animal, I have divided animals into rational and non-rational. When I define a Term as a word or a group of words that can form a Subject or Predicate in a Proposition, I have divided words into categorematic and syncategorematic. Thus Definition implies Division.

3. RULES OF LOGICAL DIVISION. Let us take the class—student. How shall we divide it? Obviously, we are not restricted to a single Division. The class 'student' may be divided into married and unmarried, rich and non-rich, intelligent and non-intelligent and so on. Each of these divisions is based on some character, which is found in some members of the class and not in others. This character is known as the basis of Division or *Fundamentum Divisionis*. Every division must be based on a single

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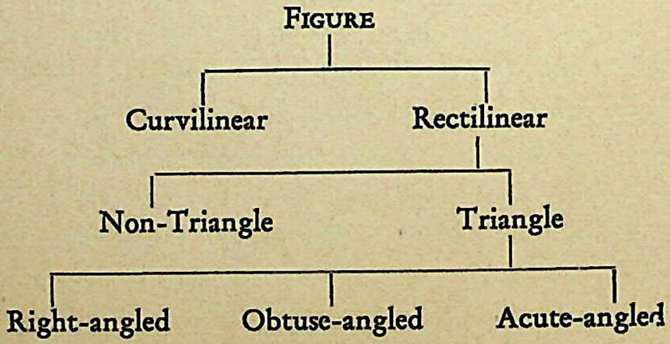
[1] Veitch: *Institutes of Logic*, 216

basis; if we have more than one basis, the division will be illogical. If I say that students are married, resident, rich or poor, the division is worthless, because the same individual may be married, resident and rich. Again, the object of division is to split up the genus into its component species. The basis of division must be a character that is found in some species and not in others; only thus can it serve as a differentiating mark. Such a character is the Separable Accident. The differentia, the properties and the inseparable accidents being present in all the members of the class cannot serve as the *Fundamenta Divisionis*. It is absurd to divide triangles into three-sided and non-three-sided, into those that have their internal angles equal to two right angles and those that have not. It is equally absurd to divide slaves into those that are free and those that are not. Our first rule of Logical Division is this:—

1. For each act of Division, there must be a single basis and that must be a Separable Accident.

The words 'for each act of Division' are important. Often a Division consists of several steps, as—



In the first step, the basis of Division is the *straightness* of the enclosing lines; in the second, it is the *number* of these lines; in the third, it is the *magnitude* of the angles. It is impossible to go on with our Division, unless we change the basis with every new step in the process.

II. The dividing members or the Species into which the Genus is divided must be mutually exclusive.

This is not an independent rule. If we observe the first rule, our species will necessarily be mutually exclusive. When this rule is violated, the species generally overlap each other and we get a *Cross Division*. An instance of cross-division has already been given under the first rule. If we divide 'students' into married, intelligent and resident, several members of the group may fall in all these compartments. It is not essential that wherever we have more than one basis of Division, the species must overlap. 'Triangle' may be divided into scalene, isosceles and equiangular. There is no overlapping here, but we have a logical cross-division.

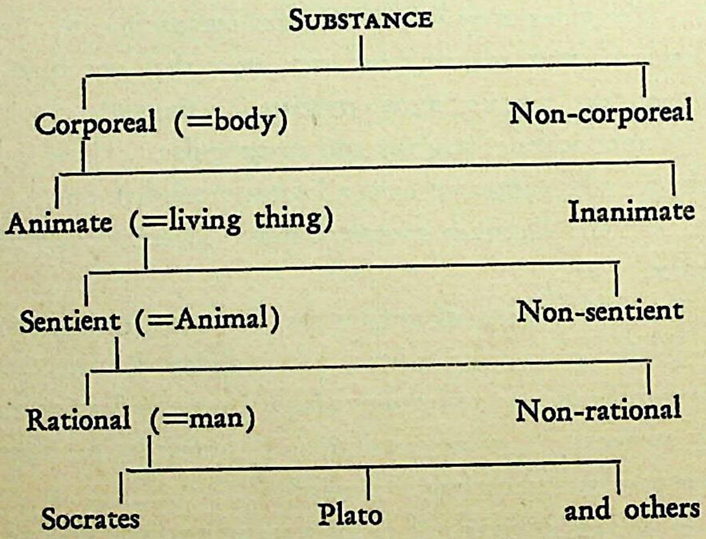
III. The dividing members must be collectively exhaustive.

This rule guards us against the defect of leaving some part of the genus unconsidered. If I divide the class 'student' into historians and philosophers, I may be leaving out many students. Similarly, a division of 'quadrilateral figure' into square and rhombus is illogical.

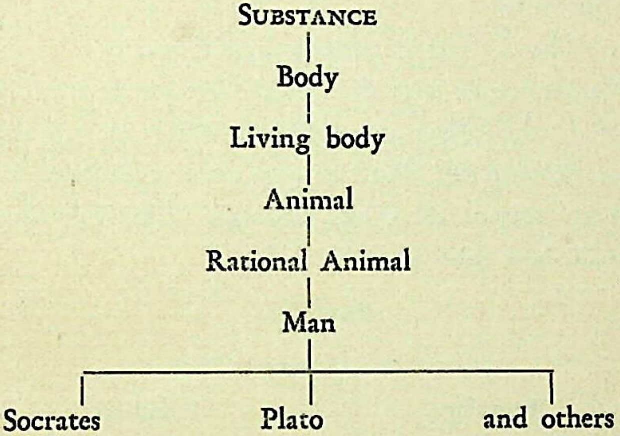
IV. The Division, if it involves more than one step, must be orderly, i.e., must proceed from step to step.

This requires that there should be no leaps in our division. The species that we get must be of *co-ordinate rank.* If 'figure' is divided into curvilinear, rhombus and equilateral triangle, then apart from other defects that there may be in the division, we have species that are of very different orders of generality.

4. Division by Dichotomy. Division by Dichotomy is the division of a class into two complementary classes; as, 'triangle' may be divided into equiangular and non-equiangular. Such a division can be carried on through several steps, but at each step, one of the members is left alone. This is shown by *Porphyry's Tree*:—



As Stock points out, the Tree of Porphyry is a device added by later writers. Porphyry himself does not give us a Division by Dichotomy, for he omits the Indefinite term at each step. He simply arranges the category of Substance as follows:—



5. **VALUE OF THE DIVISION BY DICHOTOMY.** The division by Dichotomy satisfies the rules of Formal Division, and, from the point of view of Formal Logic, it is faultless. It is based, at each step, on a single basis; is orderly; and gives us mutually exclusive and collectively exhaustive dividing members. For this reason some writers on Formal Logic recommend that Logical Division should always be Division by Dichotomy. It may be noted, however, that this Division is open to the following objections:—

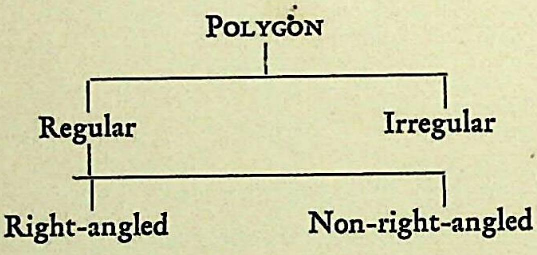
1. At each step it leaves one of the sub-classes altogether undefined in its extent.

This will be clear, if we just refer to Porphyry's Tree given above.

There, non-corporeal substances, inanimate corporeals, non-sentient living things and non-rational animals are left quite indefinite.

2. The division is entirely hypothetical.

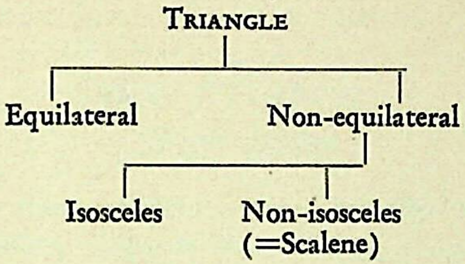
We cannot be sure that all the compartments that we provide for the species are occupied. What we call the Definite or Positive sub-class has some positive content, but we cannot say this of the other sub-class. The following instance will show this:—



The division is *formally faultless*, but we know that the compartment provided for right-angled polygons must be empty.

3. The Division is cumbrous.

It employs more steps than are essential for getting the *infima species*. While dividing 'triangle,' every one can see that the sides must be all equal, or two of them must be equal or all of them must be unequal. This result will be obtained by Division by Dichotomy thus:—



In answer to this objection, it may be said that Division without the help of Dichotomy is possible in some simple cases like this one of 'triangle,' but generally we cannot be sure that the division is exhaustive unless we dischotomise.

CHAPTER VIII

PROPOSITIONS

1. **PROPOSITIONS AND THEIR KINDS.** We have defined judgment as an act of thought, connecting two concepts. A judgment expressed in language is called a *Proposition* and the verbal expression of a concept is called a Term. We may define a Proposition as the enunciation of a relation between two Terms. The two terms are called the *Subject* and the *Predicate*. The link of connection is known as the *Copula*.

The *Subject* is the term of which something is affirmed or denied.

The *Predicate* is the term which affirms or denies something of the subject.

The *Copula* is the link of connection between the subject and the predicate and is either affirmative or negative.

This is the analysis of the simplest form of the Proposition. 'Man is mortal.' Here 'man' is Subject, 'is' is Copula and 'mortal' is Predicate. 'God is not unjust.' Here 'God' is Subject, 'is not' is Copula, and 'unjust' is Predicate.

The indicative sentence or proposition of the simple type instanced above is known as the *Categorical Proposition.* Its symbolic representation is S is P, or S is not P. (S is the first letter of the word subject, and P of the word predicate.) The elements are two terms simply or absolutely connected together by the copula. In some propositions the elements are not terms, but clauses. These are called *Complex Propositions* and are of two kinds:—

1. Conditional, Hypothetical or Conjunctive:

If A is B, C is D.

If the rain falls, the streets become muddy.

If the college remains closed to-morrow, we shall go to the river.

2. Disjunctive:

Either A is B or C is D.

This man is either a doctor or a pleader.

Either my brother will be here to-morrow or I shall go to see him.

In the Conjunctive Proposition, the elements are called *Antecedent* and *Consequent*.

The relation between these elements is not of simple agreement or disagreement, but of *dependence* of the one upon the other. 'If the rain falls, the streets are muddy.' I do not affirm that the rain does fall now or that the streets are muddy. I do not even affirm that I have ever seen the rain falling. All that is affirmed is the dependence of the consequent upon the antecedent. Neither the antecedent nor the consequent has an existential import.

In the Disjunctive Proposition, the elements are clauses related one to the other as *Alternatives*. 'Either he is a fool or he is a knave.' The proposition asserts that if one of the alternatives is not true, the other necessarily is. I do not affirm that he is a fool, nor that he is a knave: but simply that both the statements 'he is a fool' and 'he is a knave' are not false.

To sum up—A Proposition assumes the following three forms:—

(1) Categorical. A is B; A is not B.

Here the elements are terms and the relation between them is of simple agreement or disagreement.

(2) Conjunctive. If A is B, C is D.

Here the elements are clauses and the relation between them is that of dependence of the one upon the other.

(3) Disjunctive. Either A is B or C is D.

Here also the elements are clauses, but the relation between them is that of alternatives.

As we shall see, the conjunctive and the disjunctive can be reduced to the form of the categorical proposition. Reserving their consideration for a future section, we proceed to discuss the Categorical Proposition.

2. THE CATEGORICAL PROPOSITION. The categorical proposition has been symbolically represented above as S is P or S is not P. In both these forms, the subject is quantitatively undetermined. In the logical form of the proposition, it is necessary to say explicitly whether P is affirmed or denied of the entire class S or of a part thereof. The logical forms are—All S is P and No S is P, if the predication is made of the whole class S; and Some S is P and Some S is not P, if the predication is made of a part of the class. In 'All S is P,' 'All S' is the *Subject* and 'S' is the *Subject Term*. Some logicians make a similar distinction

in respect of the predicate, and say that 'is P' is the Predicate, and 'P' the Predicate Term. If we accept this view, we shall have to maintain that a Categorical Proposition has two parts—Subject and Predicate. There are some logicians who, though they would not merge the Copula in the Predicate, refuse to accept it as a part of the proposition, co-ordinate with the Subject and the Predicate. The Copula is the link that connects two terms and makes them Subject and Predicate in a proposition. No term, unless so connected, is Subject or Predicate. The Copula is the act or *form* of judging, the Subject and the Predicate are the *matter* judged.

3. VARIOUS FORMS OF THE CATEGORICAL PROPOSITION. Categorical Propositions can be divided on several bases. Two of these bases have already been suggested. The connection between the two terms may be that of agreement or disagreement. This gives us two kinds of categorical proposition—*Affirmative* and *Negative*. The basis of division here is *Quality*. 'The horse is a noble animal'; 'To be honest in his dealings is the duty of every man'; 'Two and two make four.' All these Propositions are Affirmative. 'The sun is not inhabited'; 'The college is not closed today'; 'My pencil does not work well.'. These are instances of a Negative Proposition. Again, an affirmation or denial may be made of a whole class or a part of it. This division, based on *Quantity*, gives us *Universal* and *Particular* Propositions. 'All men are mortal'; 'No crow is white'; 'All knowledge is valuable.' These are Universal Proppositions. 'Some Hindus are Barristers'; Some students are not earnest about their work'; 'Some

monkeys are very intelligent.' These are instances of a Particular Proposition. In all these propositions we know definitely whether the predication is made of the whole class or a part of it. For this reason they are called *Definite or Predesignate*, as contrasted with the *Indefinite or Preindesignate* propositions, in which the subject is not definitely quantified. When a man says—'Hindus have a poor physique,' or 'The Americans are very enterprising,' he does not definitely state whether he affirms something about all Hindus or Americans, or only about some of them. Logic demands precision in expression, and, therefore, refuses to accept the Indefinite Proposition as a regular proposition. In ordinary language, the Indefinite Proposition is sometimes understood as Universal, but in Logic we may always treat it as Particular. The statement may be universally true, but there is nothing to show that it is. Sometimes the subject of the proposition is a Singular Term. A proposition that has this feature is called a *Singular Proposition*. 'Lahore is the seat of a University'; 'Mohan Lal is captain of the cricket eleven.' These propositions are treated as Universal, because, though the subject is not a class, it is referred to as a whole. On the basis of Quantity, the Categorical Propositions may be divided thus:—

(1) Definite
  - Universal
  - Particular

(2) Indefinite

(3) Singular

The Indefinite Proposition is not recognised as an independent logical form, and is treated as Particular; the Singular is treated as Universal. This gives us two kinds of the Categorical Proposition—Universal and Particular.

If we combine these two bases, Quality and Quantity, we get the following *fourfold classification of Propositions*:—

(1) Universal Affirmative:
All S is P. All crows are black.

(2) Universal Negative:
No S is P. No chair can write an essay.

(3) Particular Affirmative:
Some S is P. Some books are well written.

(4) Particular Negative:
Some S is not P. Some tables in the college are not new.

These propositions are referred to as *A, E, I* and O. A and I are the first two vowels in *Affirmo* and E and O occur in *Nego.*

Two points about these propositions deserve special notice. The first is the *expression of the Universal Negative.* The reader may think that 'All S is not P' would be a better form. Yes, it would be, only if in common speech such a sentence meant a universal denial. As it is, it does not deny universally. 'All the students of the class are not present,' denies the presence, not of everyone of the students, but only of some, possibly one. The absence of the whole class is negatively expressed by the proposition—'No student is present.' Propositions of the form—All S is not P—are, therefore, particular negative, though the sign of quantity affixed to the subject term would make them appear to be universal. The other point to be noted is the meaning of 'Some.' 'Some' may mean 'only some' 'some at most.' In ordinary language, it means this. When a man says that some of his books are in a wretched condition, he implies that there are others that are not in a wretched condition. In Logic, 'some,' means 'some at least.' 'Some of my books are in a wretched condition,' only affirms that at least one of my books is in this condition. It does *not* imply that others are not. I may not know about them, or knowing that they are all in a wretched condition, may not care to say they are. Anyhow, I confine my assertion to a part of my collection of books and you have no right to understand my assertion to imply anything about the remaining books. This idea is sometimes expressed by saying that 'some' in Logic means 'some at least, may be all.'

4. TRUE AND FALSE PROPOSITIONS. Propositions are also divided into True and False. If the relation of agreement or disagreement asserted to exist between the subject and the predicate does actually exist between the things denoted by these terms, the proposition is true; otherwise, it is false. 'Some Hindus are highly cultured'; 'Some triangles are four-sided.' The first proposition affirms that culture of a high degree is an attribute of some Hindus. If one Hindu is, in fact, highly cultured, the proposition is true. The second proposition predicates four-sidedness of some triangles. No triangle can, however, have

the attribute of being four-sided, and so the proposition is false. The distinction of true and false among propositions is extremely important in science and in everyday life. But formal logic is concerned with consistency of thought and cannot undertake to determine whether a proposition is true or false. In connection with propositions, its sole business is to determine the conditions of their mutual compatibility and incompatibility, and to draw out their implications.

5. **ANALYTIC AND SYNTHETIC PROPOSITIONS.** In some propositions, the predicate is a concept already included in the subject and adds nothing new to it. Such propositions are called Analytic; as, 'A material body is extended'; 'Man is rational'; 'Triangles have three sides.' Every one who understands the meaning of material body, knows that it is extended; every one who knows what a triangle is, knows also that it has three sides. The predicate only analyses the subject. These propositions are contrasted with Synthetic Propositions in which the predicate is a new concept added to the subject; e.g., 'Night is meant for rest'; 'My cousin is 26 years of age.' Here the predicate concept is not included in the subject. A man who may very well understand the connotation of the words 'my cousin,' may know nothing about the age of my cousin now. Analytic propositions are also called *Explicative*, *Verbal* or *Essential*. Synthetic propositions are also called *Ampliative*, *Real* or *Accidental*.

Definitions are the most important class of Analytic Propositions.

Synthetic Propositions affirm relations of several types as subsisting between the subject and the predicate. Bain mentions the following kinds of relations:—

(*a*) Equality or Inequality.
(*b*) Co-existence.
(*c*) Succession.

Some simple examples will illustrate them.

(*a*) Equality or Inequality.

Whenever we measure quantities of any sort, we make statements predicating equality or inequality; e.g., Russia is stronger today than ten years ago; Man is more intelligent than brutes; Two and two make four; The three angles of a triangle are equal to two right angles.

(*b*) Co-existence

This is of two kinds—(i) Co-existence in Space, (ii) Co-existence or Co-inherence of attributes in an object. Co-existence in Space describes *order in place;* e.g.,James lives next-door to me; The book is on the table. Co-inherent attributes are distinguishable but not separable: as, A line has length and direction; The mind knows, feels and acts.

(*c*) Succession

Succession also appears in two forms—(i) mere Order in Time, and (ii) relation of Cause and Effect.

Mere temporal order is illustrated in the following propositions—The college was closed after the match was over; James was killed before his father left the country. Propositions of Cause and Effect figure very prominently in

Natural Sciences, and Inductive Logic is mainly occupied with them.

Examples: Heat expands bodies; Combustion of coal converts water into steam; Severe punishments tend to decrease crime.

The various forms of the Categorical Proposition that we have so far considered may be exhibited in a tabular form thus:—

(1) On the basis of *Quality*—
  (i) Affirmative.
  (ii) Negative.

(2) On the basis of *Quantity*—
  (i) Universal.
  (ii) Particular.

(3) On the basis of quality of *Matter*—
  (i) True.
  (ii) False.

(4) On the basis of *Import*—
  (i) Analytic.
  (ii) Synthetic.

4. MODAL PROPOSITIONS. The simple categorical proposition enunciates the connection that exists between the Subject and the Predicate. When in addition to this simple enunciation, we state the *mode* or manner in which the terms are connected, we get a modal proposition. Aristotle gives a fourfold division of such propositions:—

(*a*) *Necessary.*—As, 'Two and two must be four.'

6

Here the relation is necessary and unchangeable; the terms cannot but be related in the way in which they are related.

(*b*) *Contingent.*—As, 'My younger brother is named Mohan.'

These propositions state relations which, for aught we know, may not have existed.

(*c*) *Possible.*—As, 'Charcoal may be turned into a liquid.' This means that there is nothing inherent in the nature of charcoal that should render its liquefaction impossible.

(*d*) *Impossible.*—As, 'A cannot be B as well as non-B.'

The point of view adopted by Aristotle is objective. Kant, on the other hand, adopts the subjective point of view and gives a classification based on the kind of certainty or belief with which we make or accept an assertion. On this basis, he divides propositions (or rather judgments) into three classes:—

(*a*) Apodeictic. As, 'A *must be* B';
'A *cannot be* B.'

(*b*) Assertoric. As, 'A *is* B.'

(*c*) Problematic. As, 'A *may be* B.'

Does modality belong to the Copula? In the form in which we have stated the propositions, it appears to belong to the Copula. Some logicians hold, however, that the Copula is always in the form of the verb *to be*. If we accept this view, we shall have to maintain that the modal propositions, as given by Aristotle or Kant, are not in strict logical form. They can be changed into this form thus:—

A must be B=That A is B is necessary.
A is B=That A is B is a fact.
A may be B=That A is B is possible.

5. **EXCEPTIVE AND EXCLUSIVE PROPOSITIONS; EXPONIBLES.** The propositions that we have so far considered are all logical in form. Besides these, there are some propositions which are not expressed in the logical form but which may be reduced to it. One of them is the compound sentence or *Exponible*. This is not a single proposition, but a number of propositions put together. As, 'John and James are good speakers.' This is equivalent to two Categorical propositions —(1) John is a good speaker, (2) James is a good speaker. 'Mathematics and Philosophy are interesting subjects.' This is equal to—(1) Mathematics is an interesting subject, (2) Philosophy is an interesting subject. The mere fact that the subject is composed of terms conjoined by 'and' does not make a proposition an Exponible. 'Two and two make four.' This is a Categorical and not an Exponible proposition. The *Exceptive Proposition*, while making a predication, excludes or excepts some part of the subject; as, 'All but Ram Lal appeared at the examination.' 'All terms excepting proper and simple abstract names have a double meaning.' The *Exclusive Proposition* mentions the part of the subject of which alone the predicate is affirmed or denied. 'Only the brave deserve the fair.' 'Graduates alone are eligible for the post.'

The reduction of these propositions to the simple Categorical form is an interesting exercise. We shall illustrate the method by a few examples.

(1) All but Ram Lal appeared at the examination.

=All students other than Ram Lal appeared at the examination.

This may be analysed into (*a*) Some students appeared at the examination, (*b*) Some (Ram Lal) did not appear at the examination.

(2) Graduates alone are eligible.
=No non-graduate is eligible, *or*
All eligible persons are graduates.

(3) Only the brave deserve the fair.
=No non-brave men deserve the fair, *or*
All deservers of the fair are brave.

(4) None but rate-payers can vote in the election.
=No non-rate-payer can vote in the election, *or*
All those that can vote in the election are rate-payers.

The Exclusive and the Exceptive propositions are only different forms for expressing the same meaning and can easily be changed one into the other. 'Only the brave deserve the fair'='None but the brave deserve the fair.' 'None but graduates are eligible'='Graduates alone are eligible.' The excepted part of the one becomes the exclusive subject in the other and *vice versa*. The quality of the proposition is, of course, changed.

6. COMPLEX PROPOSITIONS. As has already been said, these are of two kinds—

(i) Conjunctive.
(ii) Disjunctive.

The *Conjunctive* proposition may be expressed thus—

(i) If A is B, C is D.

If the rain falls, the streets become muddy.

(ii) If A is B, it is D.

If a student works hard, he passes the examination.

(iii) If A is B, C also is (or C is B).

If you go to Srinagar, I go there too.

(iv) If A, then B. (Here, A and B are not terms, but clauses.)

The Conjunctive Proposition can be reduced to the Categorical form thus—

A being B is the condition of C being D.
A being B is the condition of A being D.
A being B is the condition of C being B.
A student's working hard is the condition of his passing the examination.

Sometimes the Conjunctive Proposition is expressed as AB is CD; AB is AD; AB is CB.

The *Disjunctive* Proposition can be expressed thus—

(i) Either A is B, or C is D.

Either the college closes tomorrow or I manage to be ill.

(ii) A is B or C.

A successful man is either intelligent or industrious.

(iii) A or B is C.

Mohan or Sohan is the captain of the team.

(iv) A or B. (Here, A and B are clauses.)

'Either A is B, or C is D,' is equal to the Conjunctives—

(1) If A is not B, C is D.

(2) If C is not D, A is B.

It can be reduced to the Categorical—A being not B is the condition of C being D.

7. The Distribution of Terms in a Categorical Proposition. The forms of the Categorical Proposition that are important from the point of view of Logic are *A*, *E*, *I* and *O*. *A* and *E* are Universal propositions, and so make the predication (affirmation or denial) of the *whole class* denoted by the subject. Using technical language, we may say that they distribute the subject. A term is said to be distributed when it is referred to in its whole extent. In *A* and *E* the subject is so referred to, and, therefore, is distributed. 'All horses are quadrupeds.' 'No crow is red.' In the first proposition, I affirm fourfootedness of the entire class of horses; in the second, I deny redness of the entire class of crows. The propositions *I* and *O* refer only to a part of the subject and thus do not distribute it. 'Some Hindus are graduates.' 'Some noses are not well-formed.' Here reference is made only to a part of the class of Hindus or noses. Our result is that *Universal Propositions distribute the subject; Particulars do not.*

What can we say about the Predicate? We must enquire whether, in a given proposition, we refer to the whole class denoted by the Predicate, or only to a part of it. Let us take the propositions one by one.

(i) *A*. All S is P. All horses are quadrupeds.

Here, do we refer to the whole class P or quadrupeds? Obviously not; P may coincide with S and there may be no quadrupeds besides the horse, but there is nothing in the proposition to show that this is the case. It is possible that there are quadrupeds besides the horse. 'All men are mortal'. Here too we are not referring to the entire class of mortals. The predicate in A is not distributed.

(ii) *E*. No S is P. No triangle is four-sided.

Are triangles excluded from the whole class of four-sided figures or only from some of them? Even if we do not understand the meaning of the words triangle and four-sided, we know from the form of the proposition that the class 'triangle' and the class 'four-sided' figure are mutually exclusive. In 'no crow is red,' we refer to the entire class of red things and affirm that it does not include any crow. In *E*, the Predicate is distributed.

(iii) *I*. Some S is P. Some Hindus are graduates.

Here, it is possible that no graduate is other than a Hindu, but the proposition does not show this. There may be graduates belonging to other races or religions. Reference is not made to the entire class of graduates, and so the Predicate is undistributed.

(iv) *O*. Some S is not P. Some Frenchmen are not cultured.

Here, we have a part of Frenchmen in our mind and exclude them from cultured society. Our present question is—Is this definite set of Frenchmen excluded from the entire cultured society or from a part of it only? Obviously, if these men were excluded only from a part of cultured society (say, the part living in Paris), and not from some other part (say, the part living in the South of France), they would be cultured still and the proposition given would be false. Our object is not to find whether the proposition is true or false, but only to see how much of the Predicate class it refers to. If some Frenchmen are not cultured, they must be out of the entire cultured society. 'Some students are not earnest about their work.' Here the speaker has a group of students in his mind and excludes them from the entire class of people, earnest about their work. There would be no point in saying that they are excluded only from a part of the class of earnest people. The proposition O distributes its predicate.

This is perhaps the hardest point to grasp in the whole doctrine of the Distribution of Terms.

Summing up our results, we can say that *Negative Propositions distribute their Predicate; Affirmatives do not.*

Combining these two principles, we find that—

A distributes its subject only.

E distributes both subject and predicate.

I distributes neither of its terms.

O distributes its predicate only.

These results are exceedingly important and the student must make himself thoroughly familiar with them.

8. QUANTIFICATION OF THE PREDICATE. In the fourfold scheme of Categorical propositions that we have adopted, the sign of quantity is attached to the subject only. Sir William Hamilton thought that this was an arbitrary limitation, and proposed that the sign of quantity be attached to the Predicate as well. This is known as the doctrine of Quantification of the Predicate. If we adopt the suggestion, we get the following classification of propositions—

(1) All S is all P. (*U*)
(2) All S is some P. (*A*)

(3) No S is any P. (*E*)
(4) No S is some P. (η)

(5) Some S is all P. (Y)
(6) Some S is some P. (*I*)

(7) Some S is not any P. (O)
(8) Some S is not some P. (ω)

The doctrine of quantification of the predicate has been severely criticised and the new propositional forms that it seeks to introduce have failed to win recognition. There are two points that are urged against it. In the first place, Hamilton's fundamental contention that the predicate is quantified in thought is denied. It is maintained that the predicate of a proposition is interpreted not in extension, but in intension. We shall return to this point in the next chapter, where we consider the question of the Import of a Proposition.

The second point is that this scheme gives us some redundant forms. Even if we quantify both the predicate and the subject, their relations do not amount to eight. Let us take S and P in extension. In what different ways can they be related? Obviously, S may (*i*) coincide with P, (*ii*) fall altogether out of P, (*iii*) intersect P, (*iv*) fall within P or (*v*) include P as a part.

This means that even if we adopt Hamilton's view, we get the following *Five Forms*:—

(1) All S is all P.
(2) No S is any P.
(3) Some S is some P.
(4) All S is some P.
(5) Some S is not any P.

CHAPTER IX

THE IMPORT OF PROPOSITIONS. DIAGRAMMATIC REPRESENTATION OF PROPOSITIONS

1. **The import of a Categorical Proposition**—The categorical proposition can be symbolically represented as S is P or S is not P. As we have seen, the copula expresses the relation of agreement or disagreement between the two terms. The verb 'to be' also means 'to exist'; as, God is. Does the copula in the ordinary proposition imply the existence of the subject? Opinion on this point is not unanimous. Some Logicians are of opinion that the copula has no existential import. The proposition, S is P, should be understood to mean—S, *if any such there be*, is P. Others maintain that the subject of the proposition is always assumed to exist. It may not exist in the world of reality, but in some Universe it must exist. Fairies and centaurs may have no objective existence, but they do exist in the Universe of Folklore and Mythology.

Another point that must be considered in this connection is the interpretation of the two terms in a proposition. As we have seen, a term may be understood in extension or in intension. How are we to understand the subject and the predicate?

There are four possibilities:—

(*i*) The subject and the predicate may both be taken in extension.

(*ii*) The subject and the predicate may both be taken in intension.

(*iii*) The subject may be taken in extension, and the predicate in intension.

(*iv*) The subject may be taken in intension, and the predicate in extension.

Let us take a simple proposition—'Man is mortal,' and interpret it according to each of these views.

The first view, which is called the *Denotative, Class-inclusion* or *Class-reference* view, interprets the proposition thus—The class of men is included in the class of mortals. The second view, known as the *Attributive* or *Connotative* view, interprets the proposition thus—Humanity and mortality go together; wherever we find humanity, we also find mortality accompanying it. According to the third view, known as the *Predicative* or Denotative-Connotative view, we affirm that each member of the class 'man' has mortality as one of his attributes. According to the fourth view, which may be called *Connotative-Denotative*, the proposition means that wherever we have humanity, we meet with a mortal.

Which of these views shall we adopt? The question can be considered from the *psychological* as well as from the *logical* point of view. From the first point of view, our aim is to find what occurs in our mind when we make the judgment. From the point of view of Logic, our aim is to determine which mode of interpreting the proposition is helpful to thought.

The Connotative view, advocated by Mill, is tenable neither psychologically nor logically. When I say that crows are black, I am not thinking of *crowness*. It may be true that the denotation of 'crow' has been determined by its connotation, and that I call a bird a crow on account of its possessing a definite set of attributes. I do not, however, keep this connotation always in my mind. In affirming 'Crows are black,' the subject is interpreted in denotation. Nor is this view of much help in determining the mutual relations of propositions. The Connotative-Denotative view is of very limited importance. This is the natural interpretation where our object is to identify something. 'All that glitters is not gold.' This means that wherever we have the attribute 'glitter,' it is not necessary that we meet with gold. 'All liquid metal is mercury.' This means that wherever we find a combination of liquidity and metallicness, we can say that the thing is mercury. The Predicative view is the soundest view *psychologically*. When we make a judgment, we understand the subject in extension and the predicate in intension. The Denotative view is untenable from the psychological standpoint. When a man says that snow is white, he has no clear idea of the class of white things in his mind. The predicate stands for an attribute that belongs to the subject. In Logic, our main object is to know about the relations, implications and interdependence of propositions. As we shall see in the sequel, the denotative interpretation of the proposition is an aid to thought in its effort to realize this end. For the purposes of Logic, then, the Denotative view is the most satisfactory.

2. DIAGRAMMATIC REPRESENTATION OF PROPOSITIONS —'Diagrams are intended to make obvious at a glance, the relations between the terms expressed in a proposition.' (Welton.) This is their primary object; they also serve to express the relations of propositions, *i.e.*, they show what propositions are mutually compatible or incompatible, and what combinations of propositions yield a conclusion. This will be obvious in the sequel, when we discuss Immediate and Mediate Inferences. In this section we confine ourselves to their function in regard to single propositions.

Diagrams in order to be satisfactory must satisfy the following conditions—

(1) They should be self-interpreting, as soon as the principle on which they are constructed is understood.

(2) They should be able to represent all the propositional forms recognised in Logic.

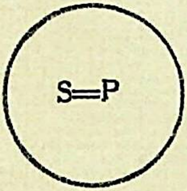
(3) They should be able to represent not only single propositions, but also combinations of propositions.

(4) One diagram should represent one proposition only, and each proposition should be representable by a single diagram.

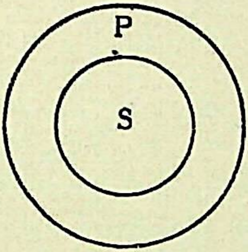
Several schemes of diagrams have been proposed and are discussed in books on Logic. The best known of them all is the scheme of Euler's Circles.

Euler's Circles.—This scheme, as every other scheme of diagrams, rests upon the Class-Inclusion view of the Import of Propositions. The classes are represented by circles, and their relations by partial or total coincidence, or mutual exclusion. The relation between S and P, when both are read in extension, will be one of the following—

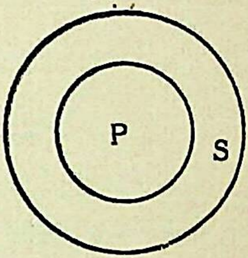
(*a*)



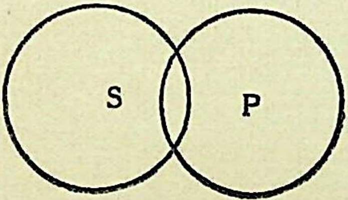
(*b*)



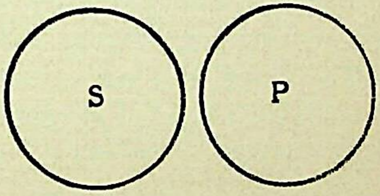
(*c*)



(*d*)



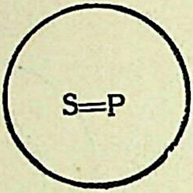
(*e*)



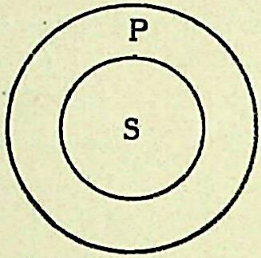
If we adopt the fourfold classification of propositions, the last condition of a satisfactory scheme of diagrams is not satisfied. Generally, one proposition is represented by more than one diagram and the same diagram represents more than one proposition. We shall see this in some detail about each of the propositions.

A. All S is P. This means that the whole of S is included in P. The word 'included,' however, does not imply that it is included only as a part. S may be coincident with P. The symbolic form represents propositions of the two types—(1) All equilateral triangles are equiangular, (2) All men are mortal. It is represented by

(*a*)



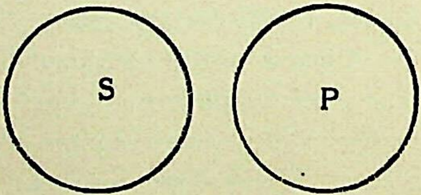
(*b*)



Some Logicians object to the representation (*a*), on the ground that though we may happen to *know* that all equiangular triangles are equilateral, the original proposition itself does not distribute the predicate. The diagram (*a*), according to them, represents a combination of two propositions—All S is P and All P is S.

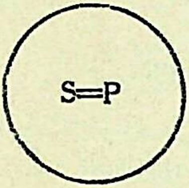
E. No S is P. This expresses total exclusion of S from P, and is represented thus—

(*e*)

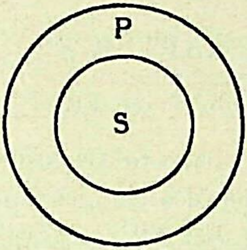


I. Some S is P. This means that S and P partially coincide but *partially at least*, not *partially only*. It does not exclude total coincidence of S and P, nor the inclusion of the whole of S within P. The relation is, therefore, represented thus—

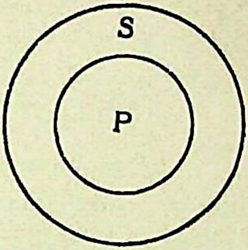
(*a*)



(*b*)



(*c*)



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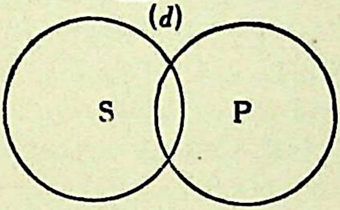
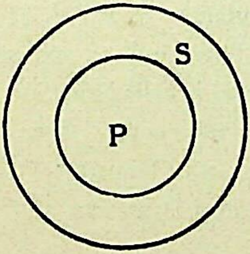


O. *Some S is not P*. This means that *a part* of S *at least* is excluded from P.

It does not exclude the case of total exclusion of S from P. The representations are

(*c*)



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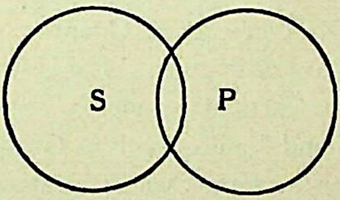

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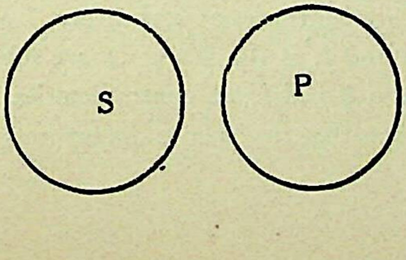


CHAPTER X

THE OPPOSITION OF PROPOSITIONS

1. THE VARIOUS FORMS OF OPPOSITION—Two Propositions are said to be opposed when they have the same matter (Subject and Predicate), but differ in Quality or Quantity or both. Let us take the four propositional forms—

A. All S is P.
E. No S is P.
I. Some S is P.
O. Some S is not P.

We find that any two of them are somehow opposed. The Propositions (i) *A* and *E* and (ii) *I* and O differ only in Quality. This kind of opposition is known as *Contrariety*, when the opposed propositions are Universals, and *Sub-Contrariety*, when they are Particulars. *A* and *I*, as also *E* and O, differ only in Quantity. This kind of opposition is called *Subalternation*. The Universal is called the Subalternant, the Particular under it, the Subalternate. *A* and O, as also *E* and *I*, differ both in Quality and Quantity. The opposition between them is complete and is known as *Contradiction*.

A and *E* are contraries of each other; *I* and O are subcontraries. *A* and *I*, as also *E* and O, are sub-alterns; while *A* and O, as also *E* and *I*, are contradictories.

The problem that we have to discuss now is this—What are the mutual relations of these four propositions from the point of view of consistency? What can we say of their mutual compatibility and incompatibility? Let us take the various forms one by one.

(i) *Contrary Propositions.*

All S is P. No S is P.

The first affirms that the whole class S is included in P; the second affirms that it is wholly excluded from P. Evidently S cannot be both wholly within and wholly without P. If it were, the Law of Non-Contradiction would be violated. Both the contraries cannot be true. Both, however, may be false, for S may partially coincide with P.

(ii) *Contradictory Propositions.*

(*a*) All S is P. Some S is not P.
(*b*) No S is P. Some S is P.

Obviously, both the contradictories cannot be true, for each of them absolutely denies the other. Can both be false? What is meant by saying that 'All S is P' is false? Clearly this, that the whole of S is not included in P. This amounts to saying that a part of S at least is excluded from P; *i.e.*, Some S is not P. Thus the falsity of the one *means* the truth of the other. The contradictories cannot both be false. Putting these two results together, we may say that of the two contradictories, one must be true and the other must be false.

(iii) *Sub-Contrary Propositions.*

Some S is P. Some S is not P.

Both these propositions *may be* ture, for S may fall partly within and partly without P. Can both be false? That 'Some S is P' is false, means that no part of S whatsoever falls within P. If this be so, S certainly is out of P, and, therefore, the other proposition must be true. Both the sub-contraries cannot be false.

(iv) *Subalterns.*

(*a*) All S is P. Some S is P.

(*b*) No S is P. Some S is not P.

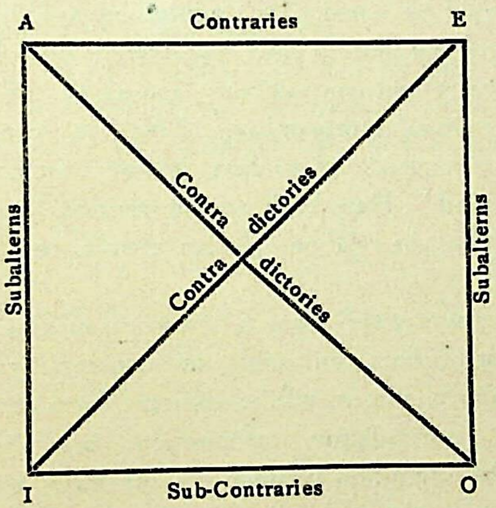
It is obvious that if the Universal is true, the Particular is true. The whole of S being included in P, part of S is, of course, included in P. Similarly, if the whole of S falls out of P, every part of S, of course, falls out of it. We cannot say, however, that if the Particular is true, the Universal also is true. I am told that some students have attended the class. Others may have attended as well, but the proposition says nothing about them. From the truth of the Universal follows the truth of the Particular, but not *vice versa.*

A and O, as also *E* and *I*, are *diametrically opposed*. The amount of opposition between them is the greatest possible. *A* and *E* are incompatible; they cannot both be true, though both may be false. By denying the one, we do not necessarily affirm the other. As expressing the relation between subalterns and sub-contraries, the word *Opposition* is used in a purely technical sense. *A* and *I* are not incompatible; rather when *A* is affirmed, we have to affirm *I*. Similarly, the sub-contraries are compatible, and, therefore, not 'opposed' in the strict sense. Strictly speaking opposition is only of two kinds—contrary and contradictory. The rules of these two kinds of opposition are—

(1) Contradictories cannot both be true, nor can both be false.

(2) Contraries cannot both be true, but can both be false.

By applying these rules and using the *Square of opposition*



we can easily get all the results so far obtained, and some results besides these as well.

What follows from the truth of A, falsity of I, and truth of O?

A being true, *E* is false (II); O, the contradictory of *A*, is false (I); and *I*, the contradictory of *E*, is true (I).

I being false, its contradictory, *E*, is true (I); *E* being true, its contrary, *A*, is false (II); and *O*, the contradictory of *A*, is true (I).

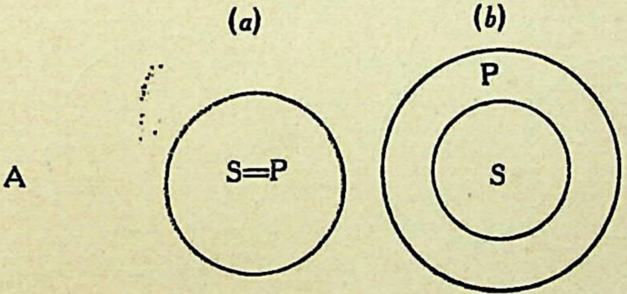
O being true, its contradictory, *A*, is false; *A* being false, *E*, its contrary, is doubtful; *E* being doubtful, its contradictory, *I*, is also doubtful.

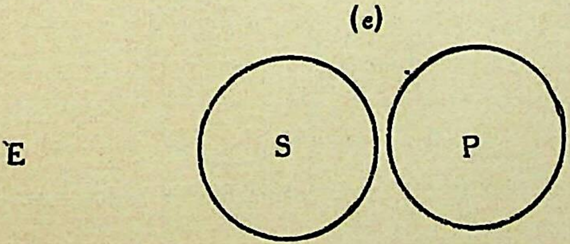
The student should work out results from the truth and falsity of propositions not considered here.

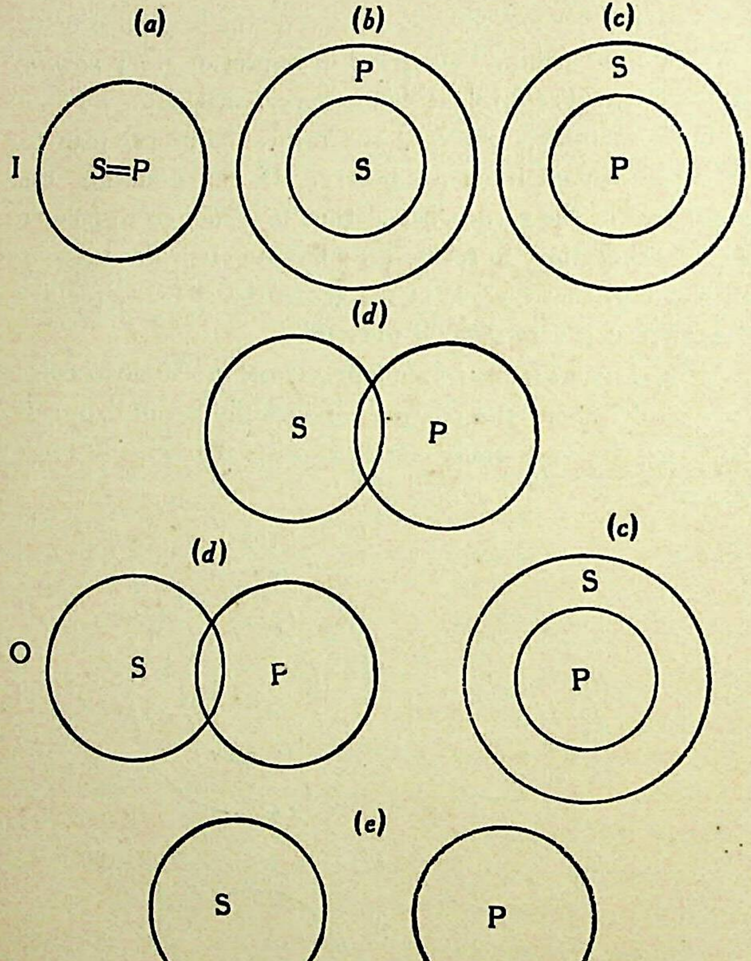
It should be noted that singular propositions have no subalternates and that, in their case, there is no difference between contrary and contradictory opposition. We may say rather that singular propositions have no contradictory. 'Ram Lal is married.' If we deny this, we must say 'Ram Lal is not married.' Here both the propositions are universal and, therefore, the relation between them is that of contrariety:

Before leaving this point, a few words may be said about the contrast between contrariety and contradiction. As has been said above, and as will be apparent form the square of opposition, contradictory propositions are diametrically opposed; the opposition between the contraries is not so absolute. Again, the contradictory of a proposition simply denies that proposition and says nothing more. The contrary goes much beyond a simple denial. 'All students in the class are married.' The proposition can be denied by maintaining that at least one student is not married. The logical form of the contradictory is—some students are not married. If you affirm that 'No student in the class is married,' you are going much beyond the mere denial of the original proposition: you are making that denial in respect of *every member* of the class. From this it should appear that when we mean to refute another's universal statement, the proper plan for us is to maintain its contradictory. If a man affirms that every tree in the garden bears fruit, it is enough to point to a single exception, to refute his position. It is not necessary to maintain that no tree in the garden bears fruit; for that, even if true, is very difficult to establish.

2. **Diagrams and the Opposition of Propositions**—Our results about the relations of logically opposed propositions can be very easily obtained with the help of Euler's circles.







Each proposition must be representable by one or more of the five forms—*a*, *b*, *c*, *d*, *e*.

A (*a* and *b*) and *E* (*e*) have nothing in common; therefore, both of them cannot be true. But as they do not cover all the possible cases, both may be false. They will both be false, if the relation between S and P is represented as in *c* or *d*. *I* and O, taken together, cover the whole ground; *i.e.*, include all possible representations. Therefore, both of them cannot be false. They have common elements, *c* and *d*, and when a proposition is represented by one of these common elements, both *I* and O are true. They are not true, however, in all cases.

The diagrams representing the contradictories are mutually exclusive. This shows that no single diagram can represent two contradictories, *i.e.*, two contradictory propositions cannot be simultaneously *true*. And the diagrams representing the contradictories are collectively exhaustive, *i.e.*, they represent all the relations in which two terms can stand to each other. This shows that both of them cannot be *false*.

The diagrams representing the Universals are included among those that represent the corresponding Particulars. If the Universal is true, the Particular is true. But the Particulars include some cases that are not included in the Universals, and when a proposition is represented by *one of these*, the Universal is not true. However, as we are not able to say whether or not the proposition *is* represented by one of these forms, we are not justified in affirming or denying the truth of the Universal. All we can say is that when the Particular is true, the Universal is doubtful.

CHAPTER XI

IMMEDIATE INFERENCES

1. **The Nature of Inference**—The word Inference is used ambiguously. It is used (*a*) for the process or act of inferring, (*b*) for the conclusion that is drawn in that process, (*c*) for the entire argument. In the absence of anything said to the contrary, in this book the word should be understood in the last sense.

'The problem of inference is something of a Paradox. Inference (*i.e.*, the act of inferring) consists in asserting as fact or truth, on the ground of certain given facts or truths something which is not included in those data. We have not got inference unless the conclusion, (*i*) is necessary from the premisses, and (*ii*) goes beyond the premisses. To put the paradox quite roughly—We have not got inference unless the conclusion is (*i*) in the premisses, (*ii*) outside the premisses.'* The essential features of an inference are (*i*) the novelty of the conclusion, and (*ii*) the necessity with which it follows from the given data. When a judgment is derived from another single judgment, we have an Immediate Inference. When the conclusion is derived from two judgments put together, the inference is Mediate. In either case, however, all that we have to do is to draw out the implications of a premiss or premisses. This shows why the conclusion should be at once new and not new. What was formerly implicit now becomes explicit. The result is new, not in the sense of being unconnected with the data, but in the sense of being presented to consciousness in a form in which it was not presented before. *To infer is to draw out the implications of the given premiss or premisses.*

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*Basanquet: Essentials of Logic. 137.

2. IMMEDIATE INFERENCES—Immediate inferences are said to be of two kinds—(*i*) Inferences by Opposition, (*ii*) Eductions. In Opposition, as we have seen, we start with a proposition assumed to be true or false, and infer from it the truth or falsity of other propositions relating to the same matter; *i.e.*, having the same subject and predicate. We have not treated these as inferences, because really our business is to examine mutual relations of two propositions. We discover the principles of contrary and contradictory opposition and apply them to determine the mutual compatibility and incompatibility of propositions. According to this view, we are given both the propositions and are only to find whether they are compatible. According to those that treat opposition under immediate inferences, we are given a single proposition and are to derive other propositions that are or are not compatible with it.

The problem of *Eduction* is to find propositions that are equivalent to the given proposition. The given proposition affirms a certain relation between two terms; in what other forms can the same relation be expressed? We are not permitted to change the meaning of the proposition, but may make any change in the quality or position of the terms. Eductions are of *four kinds*:—

(1) *Conversion.* The subject and the predicate change their position. The original proposition is called the convertend and the new form, the converse.

(2) *Obversion.* (Also called Permutation or Aequipollence.) The subject of the proposition remains unchanged, but the predicate is negatived. The original proposition is called the obvertend, and the new one, the obverse.

(3) *Contraposition.* The negatived predicate of the original proposition becomes subject, and the original subject becomes predicate in the new form.

This is nothing but converse of the obverse. The new proposition is called contrapositive.

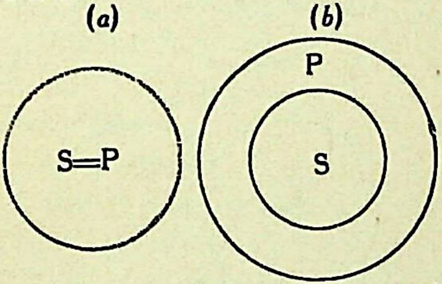
(4) *Inversion.* The contradictory of the original subject becomes subject in the new proposition and the original predicate remains unchanged. The two propositions are called the invertend and the inverse.

We shall now examine each of these Inferences in some detail.

3. CONVERSION—In the original proposition, S—P, something in affirmed or denied of S in terms of P. In the

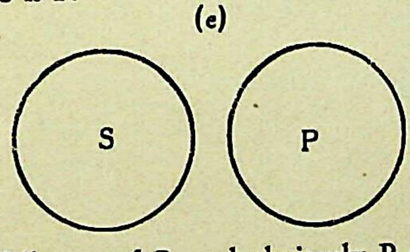
converse, the standpoint is completely changed—we affirm something of P in terms of S. Thus the old truth is presented in a fresh aspect, and we have here a genuine inference. The relation between S and P may be expressed in one of the four forms—*A*, *E*, *I* and O. Our business now is to get the converse of each one of them.

A. All S is P.



Here, S is either coincident with P, or included within P, as a part of it. If S and P are coincident, All P is S. If S is only a part of P, then only some P is S. As we are not sure whether S is equal to P, or is only a part of it, we can only say that 'Some P is S.' *A* is converted into *I*.

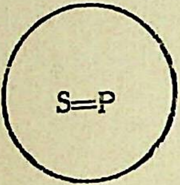
E. No S is P.



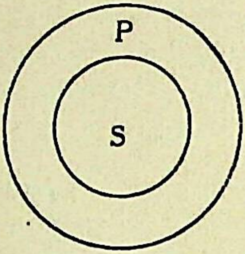
Here S falls out of P, and obviously P falls out of S. The converse is—No P is S.

I. Some S is P.

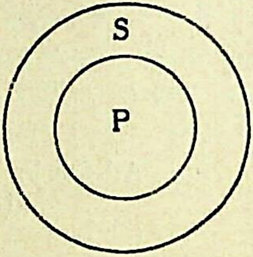
(*a*)



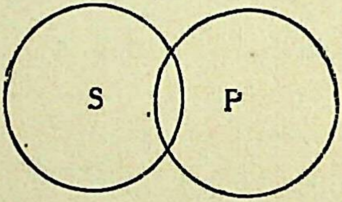
(*b*)



(*c*)



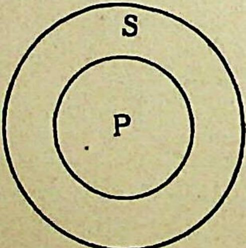
(*d*)



Here there are some S's which are also P's. As a necessary result, there are some P's which are also S's. Can we say—All P is S? This is true in cases (*a*) and (*c*), but fails in cases (*b*) and (*d*). Therefore, we can only say—Some P is S.

O. Some S is not P.

(*c*)



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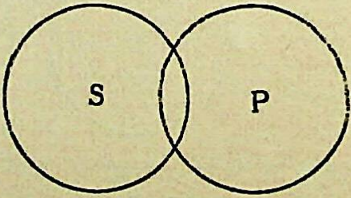
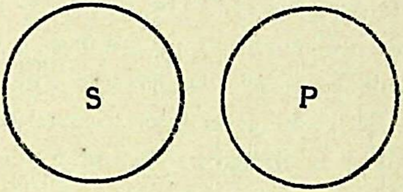


(e)



The converse, if any, must be one of the following:—

(i) All P is S.
(ii) No P is S.
(iii) Some P is S.
(iv) Some P is not S.

All P is S fails in cases (*d*) and (*e*). No P is S fails in cases (*c*) and (*d*). Some P is S fails in the case (*e*). Some P is not S fails in the case (*c*). We find that none of the four propositions succeeds in all the cases and thus none represents the original relation. This shows that O cannot be converted.

We can also obtain these results by applying what are known as the *Rules of Conversion*:—

(1) The quality of a proposition should not be changed.
(2) A term that is undistributed in the original proposition should not be distributed in the converse.

If we disregard the first rule, we shall be changing the meaning of the proposition; for a change in the quality of the proposition means the introduction of a negation, and we are justified to introduce a negation only to neutralise the effect of another negation. As the terms are unchanged, the quality of the proposition also should remain unchanged. As to the second rule, obviously, we have no right to go beyond our premisses. If in the given premiss a term is used in limited extension, it is illegitimate to use it in its total extension, in the infererd proposition.

We may apply these rules to show that O cannot be converted.

According to the first rule, the converse must be a negative proposition. A negative proposition distributes its predicate and so S will be distributed in the new proposition. S, however, is undistributed in the original proposition, and, if we get a converse, we shall be violating the second rule. Thus O cannot be converted.

To sum up:

A is converted into I.
E is converted into E.
I is converted into I.
O cannot be converted.

The proposition A suffers in quantity in the process of conversion. This conversion is called *conversion by limitation*. E and I suffer no such loss, and their conversion is known as *simple conversion*.

Examples of Conversion:

(1) No dishonest man deserves respect.

Converse—No one deserving of respect is dishonest.

(2) All equilateral triangles are equiangular.

The student is apt to use his geometrical knowledge and convert it into an A proposition. This is illegitimate, for we are not to use knowledge derived from an extraneous source. The converse is—Some equiangular triangles are equilateral.

(3) All that glitters is not gold.

This is an O proposition, meaning 'some glittering things are not gold,' and cannot be converted.

(4) Brutus killed Cæsar.

Some students write at once—Cæsar was killed by Brutus. The logical form of the proposition is—'Brutus is the killer of Cæsar.' The Converse is—Some killer of Cæsar is Brutus.

(5) B is brother of A.

Converse—Some brother of A is B. A is the brother of B may be a fact, but is not the converse of the original.

What is the converse of—B is the mother of A?

(6) No one excepting History students attended the meeting.

Converse—No one who attended the meeting is other than a History student.

4. Obversion—In Obversion, the quality of the predicate is changed. This introduces a negation, which must be neutralised, if we are to avoid a change in meaning. This is done by changing the quality of the proposition.

Thus, to obvert a proposition we have to change the quality of the proposition, and to negative the predicate.

A. All S is P.

Obverse—No S is non-P.

E. No S is P.

Obverse—All S is non-P.

I. Some S is P.

Obverse—Some S is not non-P.

O. Some S is not P.

Obverse—Some S is non-P.

The student should obtain these results by the help of diagrams.

Examples of obversion:—

(1) All crows are black.

Obv.—No crow is non-black.

(2) All the planets are inhabited.

Obv.—No planet is uninhabited.

(3) P struck Q.

Obv.—P is not other than the striker of Q.

(4) None but the brave deserve the fair.

Logical Form—No non-brave men deserve the fair.

Obv.—All non-brave men are non-deservers of the fair.

(5) All the angles of a square are right angles.

Obv.—No angle of a square is other than a right angle.

5. CONTRAPOSITION—This, as has been said above, is a compound process, comprising (*i*) Obversion and (*ii*) Conversion. The Contrapositive of a proposition is the converse of the obverse of the original.

Examples:—

(1) All crows are black.

Obv.—No crow is non-black.

Conv. of Obv.—Nothing non-black is a crow.

(2) No man is infallible.

Obv.—All men are fallible.

Con. of Obv.—Some fallible beings are men.

(3) Some Hindus are engineers.

Obv.—Some Hindus are not non-engineers.

This cannot be converted. The proposition has no contrapositive.

(4) Some of my letters are not delivered to me.

Obv.—Some of my letters are undelivered to me.

Conv. of Obv.—Some things undelivered to me are my letters.

6. INVERSION—In Inversion, the original subject is negatived. To neutralise this negation, we change the quality of the proposition. Like contraposition, this also is not a fundamental process of Eduction. The inverse of a proposition can be obtained by the alternate performance of the two elementary processes of conversion and obversion.

A. All S is P.

Obv.—No S is non-P. (1)

Conv. of (1)—No non-P is S. (2)

Obv. of (2)—All non-P is non-S (3)

Conv. of (3)—Some non-S is non-P. (4)

Obv. of (4)—Some non-S in not P. (*Inverse*).

E. No S is P.

Conv.—No P is S. (1)

Obv. of (1)—All P is non-S. (2)

Conv. of (2)—Some non-S is P. (*Inverse*).

I. Some S is P.

Obv.—Some S is not non-P.

This cannot be converted.

If we begin with conversion, we get—Some P is S, which will not yield any result beyond a single step. Therefore, *I* cannot be inverted.

O. Some S is not P.

We cannot begin with conversion.

Let us begin with obversion.

Obv.—Some S is non-P (1)

Con. of (1)—Some non-P is S. (2)

Obv. of (2)—Some non-P is not non-S.

This cannot be converted.

Thus O also cannot be inverted.

About Inversion, we note that

(1) Only universal propositions can be inverted.

(2) They suffer a loss in quantity in undergoing the change.

Examples:—

(1) All cultivated lands are inhabited.

Inverse—Some uncultivated lands are not inhabited.

(2) No dishonest man is respectable.

Inverse—Some honest men are respectable.

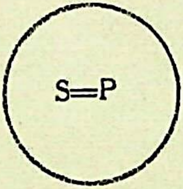
The student should find these results by going through the various steps.

The inverse of *A* and *E* can be obtained easily with the help of diagrams.

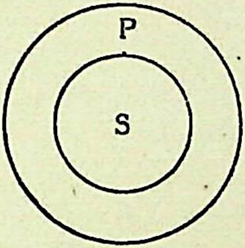
Given All S is P or No S is P, our question is—what can be said of Non-S in terms of P?

A. All S is P.

(*a*)



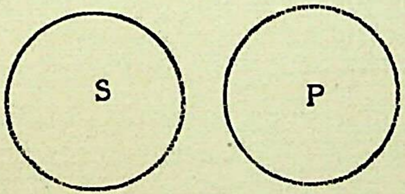
(*b*)



In (*a*), non-S falls altogether out of P; in (*b*), a part of non-S falls out of P. In both cases, we can say—Some non-S is not P. This is the Inverse of All S is P.

E. No S is P.

(*e*)



Here evidently non-S includes P as a part, and we can say that Some non-S is P.

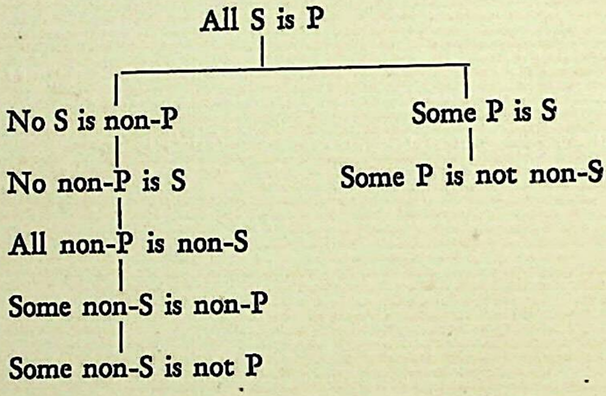
If non-S is written as S and non-P as $\overline{P}$, the changes in Eductive Inferences can all be indicated in the following table—

S—P (original).

S—$\bar{P}$ (obverse).

$\bar{S}$—P (inverse).
$\bar{S}$—$\bar{P}$ (obverse of inverse).
P—S (converse).
$\bar{P}$—S (converse of obverse).
P—$\bar{S}$ (observe of converse).
$\bar{P}$—$\bar{S}$ (obverse of converse of obverse).

All the Eductive Inferences that can be drawn from the proposition *A* can be shown in the following *Eductive Scheme*:



CHAPTER XII

THE SYLLOGISM

1. **The Structure of the Syllogism**—In dealing with immediate inferences, our object has been to discover the implications of a given proposition. Our present enquiry is to be of the same type, though somewhat more complex. We have to discover the implications of two propositions, taken together. Given two propositions, what third proposition, if any, does necessarily follow from them?

The two propositions that serve as the data, together with the third proposition derived from them, are known as the *syllogism* (=thinking together). It will be the business of this chapter to examine the structure of the syllogism and find the principles whereby we may be able to test the validity of a syllogistic argument.

To begin with, it is plain that any two propositions taken at random will not serve our purpose. A man makes two statements—(1) The earth is round like a ball, and (2) Three angles of a triangle are equal to two right angles. Nothing can be inferred from these two propositions; all that we can do is to put them together and repeat them. The propositions that can be data for a third proposition to be derived from them must *be connected*. *There must be some bond of union between them. The Syllogism is an* *argument in which from two propositions containing a common element, a new proposition follows as a necessary consequence.*

The two propositions that are the data are called the *Premisses;* the proposition that is derived from them is called the *Conclusion.* These three propositions are called the matter of the Syllogism. The terms that occur in a proposition constitute its matter and, consequently, the terms that occur in a Syllogism are ultimately the matter of the syllogism. Propositions that compose a Syllogism are said to be its Proximate matter and Terms that occur in it are called the Remote matter.

We have said that the two premisses have a common element. This means that one of the terms occurs in both the premisses. As the conclusion is derived from the premisses, its terms must be the terms that occur in the premisses. The conclusion expresses a relation between two terms, and this relation is ascertained by comparing each of these terms with the same third term. This shows that in a Syllogism altogether there are three terms—each occurring twice. The term with which the other two are severally compared, and which, therefore, serves as the bond of union between them, is known as the *Middle Term.* The other two terms are known as the Extremes. The Middle term occurs in both the premisses, but does not occur in the conclusion. Each of the extremes occurs in the conclusion as well as in one of the premisses. The term that occurs as subject in the conclusion is known as the *Minor Term,* whereas the term occurring as predicate in the conclusion is known as the *Major Term*. The premiss in which the Major Term occurs is known as the *Major Premiss*, and the premiss that contains the Minor Term is called the *Minor Premiss*. The premisses derive their distinctive names from the terms, and not the terms from the premisses.

An example will make all this clear:

All men are rational,
All Hindus are men,
∴ All Hindus are rational.

The term 'men' occurs in both the premisses and so is the middle term. 'Hindus,' being subject of the conclusion, is the minor term; and 'rational,' predicate of the conclusion, is the major term. The first proposition is the major premiss as the major term occurs in it; the second proposition is the minor premiss. Often the major premiss occurs first in the argument and that is its natural position, but we must remember that it is not the position of a premiss that makes it major or minor.

2. THE CANONS AND ARISTOTLE'S DICTUM—Having examined the structure of the syllogism, we now proceed to determine the rules which may be used to test the validity of syllogistic reasonings.

All reasoning ultimately depends upon the Laws of Thought that were discussed in a previous chapter. Logicians have, however, formulated some additional principles of a self-evident character, known as the Canons, which may be thus stated:—

(*a*) Two terms, agreeing with one and the same third term, agree with each other.

(*b*) Two terms, of which one agrees and the other does not agree with one and the same third term, do not agree with each other.

(*c*) Two terms, both disagreeing with one and the same third term, may or may not agree with each other.

Consider the syllogism—

All men are rational,
All Hindus are men,
∴ All Hindus are rational.

Here the terms 'rational' and 'Hindus' both agree with 'men,' and the conclusion affirms their agreement. Take another syllogism—

No black thing is lovely,
All crows are black,
∴ No crow is lovely.

Here the term 'lovely' disagrees, and the term 'crows' agrees with the same third term, 'black,' and the conclusion asserts the disagreement of the one with the other. In the first argument, agreement in both cases is not complete but only partial. There are other rationals besides men and the Hindus form only a part of mankind. In the second argument, the major affirms complete disagreement between black and lovely things, and the minor affirms partial identity between crows and black things.

The third canon is obvious. When both the terms disagree with the third, there is no bond of union between them, and, in the absence of such a bond, nothing can be asserted about their connection. The essence of the syllogistic reasoning lies in this that two terms are, by virtue of their connection with a third, connected with each other. Where both the premisses are negative, there is nothing to proceed upon. If we merely know that 'no crows are black' and 'no crow is a quadruped,' we are not in a position to say anything about the relation between black things and quadrupeds. If we know that some quadrupeds are black, this knowledge is derived from other sources and not from the given premisses. In syllogistic reasoning, however, our sole business is to bring out the implications of the premisses.

Logicians have expressed the first two of these canons in the form of a general principle known as the *Dictum de omni et nullo*, or simply *Aristotle's Dictum*. It runs as follows:—

Whatever is affirmed or denied of a whole class, may be affirmed or denied of every thing contained in that class.

This principle is said to be the foundation of all syllogistic reasoning, and its application is obvious in the case of arguments in the standard form. Consider again the syllogism given above—

All men are rational,
All Hindus are men,
∴ All Hindus are rational.

Here rationality is affirmed of a whole class (men), and as the Hindus form a part of this class, it is affirmed of Hindus also.

This principle does not directly apply to many syllogisms, and hence arises the need of the rules that should serve as criteria for the purpose of testing the validity of all syllogistic reasoning. These rules we shall now consider.

3. THE RULES OF THE SYLLOGISM—These are eight in number, arranged in four groups of two each:—

I.—Relating to the *structure* of the syllogism—

(1) A syllogism must contain three and only three terms.

(2) A syllogism must contain three and only three propositions.

II.—Relating to *quantity*—

(3) The middle term must be distributed in one at least of the premisses.

(4) No term must be distributed in the conclusion unless it was distributed in the premiss which contains it.

III.—Relating to *quality*—

(5) From two negative premisses there can be no conclusion. In other words: one, at least, of the premisses must be affirmative.

(6) If one premiss be negative, the conclusion must be negative; and if the conclusion be negative, one premiss must be so.

IV.—*Corollaries*—

(7) From two particular premisses there can be no conclusion.

(8) If one premiss be particular, the conclusion must be particular.

The Rules relating to Structure are of the nature of a definition. If there are but two terms, we have a single proposition and the inference from it is an Immediate Inference. If in a valid argument there are more than three terms, the argument is not a single syllogism; as in

All students in Lahore are Punjabees,
All Punjabees are Indians,
All Indians are Asiatics,
∴ All students in Lahore are Asiatics.

Again, the very definition of a syllogism requires that it shall be composed of three propositions. Two propositions with four distinct terms give no conclusion. Sometimes the middle term is used ambiguously. In such a case, we have really four terms—only two of them happen to be similar in form and partly similar in meaning. The syllogism in such a case is not valid and the fallacy that results is known as the *fallacy of four terms*, or of the *ambiguous middle*.

Rules relating to Quantity are the most important rules of the syllogism, and syllogistic fallacies that are due to the violation of one or the other of these two rules are perhaps more numerous than all the other syllogistic fallacies put together. The first of these rules requires that the middle term should be distributed at least once. In the conclusion we have to affirm a relation between two extremes and we are able to do this because each of these two terms is related to the middle term in a determinate way. Now, if the middle term is undistributed in both the premisses, it is not referred to in its whole extension and it is possible that one extreme is compared with one part of it and the other with quite a different part. In such a case, there is no bond of union between the extremes, and so really no middle term. An instance will make this clear:—

All Indians are Asiatics.
All Chinese are Asiatics.

In these two premisses, Indians and Chinese are identical with two parts of Asiatics, but, *on the ground of these two propositions*, it is impossible to say whether they agree with one another. Again, take the following:—

All Indians are Asiatics.
All Punjabees are Asiatics.

Our inability to get a conclusion is not a whit less. If we are able to say that the Punjabees are and the Chinese are not Indians, we get our light from extraneous sources and not from our premisses.

In fact in the two propositions—All P is M and All S is M, all that we positively know is that both P and S are included in M; but they can satisfy this condition and be related to each other in any one of the five ways in which two terms can possibly be related.

The second rule about Quantity requires that a term that is undistributed in the premisses should not be distributed in the conclusion. The self-evident character of this rule will be obvious, if we just consider what we mean by the distribution of a term. A term is said to be distributed when we refer to it in its entire extension. Now the rule in question only says that if a statement is made about a part of a class, it is no sufficient ground for making a statement about the whole class. If I say that some students in the class are married, I am not justified, *on this ground*, to make a statement about the whole class of students. Take the following syllogism:

All crows are black.
All crows are bipeds.
∴ All black things are bipeds.

Here the argument is fallacious because, in the premisses, I consider only a part of the class of black things, and, in the conclusion, I predicate something of the whole class of black things.

The violation of the first of these rules is known as the fallacy of *Undistributed Middle*, and the violation of the second rule, the fallacy of the *Illicit Process*. The Illicit Process may be of the major or the minor, according as the offence is committed in respect of the major or the minor term.

Among the *rules relating to Quality*, the first states that one at least of the premisses must be affirmative; or , in other words, *from two negative premisses no conclusion follows.*

It will be observed that this rule is another version of the third canon already discussed in this chapter. It is self-evident and as such requires no proof, but some logicians offer a formal proof of it. The proof is as follows:—

Let the two negative premisses be—

No M is P and No M is S.

Converting them, we get—

No P is M.
No S is M.

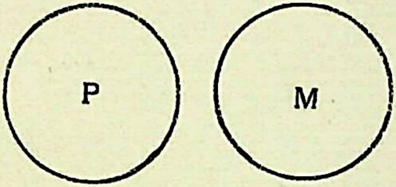
Obverting them, we have—

All P is non-M.
All S is non-M.

These two premisses are incapable of yielding a conclusion, for the middle term in them is not distributed. These are, however, our original premisses, only in a new form. Therefore, our original premisses give no conclusion. We have taken both the premisses as universal. If two universal negatives are incapable of giving a conclusion, then *a fortiori* are two particular negatives, or one particular and one universal negative, incapable of yielding a conclusion.

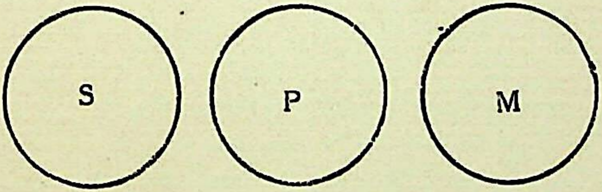
This proof assumes the principle that the middle term must be distributed at least once, and tacitly acknowledges that that principle is more fundamental than the rule about two negative premisses.

That two negative premisses can give no conclusion will be manifest if we represent the propositions by Euler's circles. Taking the premisses, No P is M and No M is S, we have to determine the relation between S and P. The premiss 'No P is M' is represented thus—

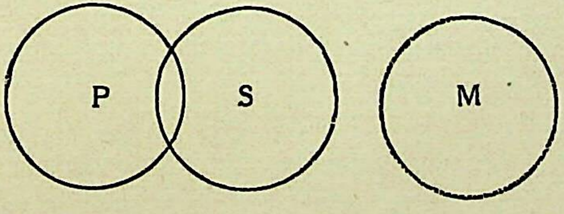


The other premiss 'No M is S' only tells us that S falls out of M; but how much and which particular part of space outside M does it occupy? On this point the premiss gives us no light. S may fall altogether out of P, may intersect it, contain it, coincide with it, or be contained in it. Thus each of the following schemes will represent the relations expressed in the premisses—

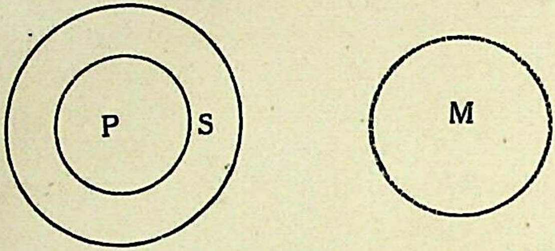
(1)



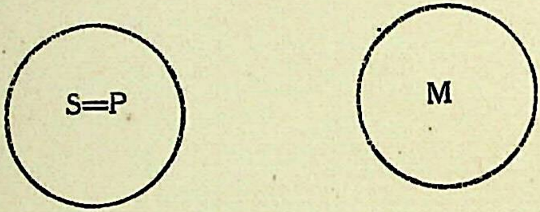
(2)



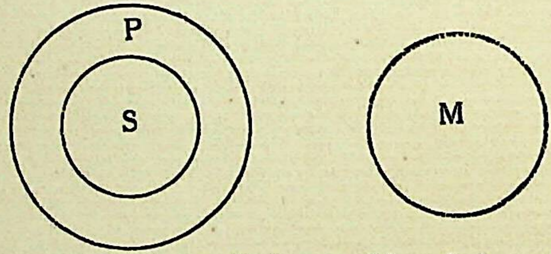
(3)



(4)



(5)



Now, we have here all the possible relations that can exist between two terms (here S and P). The two negative propositions with which we start exclude none of these relations. This means that we know nothing of the determinate relation that holds between the terms in a given case. That is, from two negative premisses we cannot draw any conclusion.

The second of the rules relating to quality states that if one of the premisses is negative, the conclusion must be negative, and that a negative conclusion can be drawn only when one premiss is negative.

A negative premiss implies that the middle term wholly or partly disagrees with one extreme. Now if the other extreme agrees with the middle term, the two extremes must disagree with one another. If crows agree with (are identical with a part of) black things and black things do *not* agree with lovely things, crows and lovely things must disagree. And on the contrary, the disagreement of the two extremes can be due only to one of them agreeing and the other disagreeing with the same third term.

The rules of the fourth group are corollaries that follow from the fundamental rules. These corollaries can be proved and require being proved, because they are not self-evident.

(*a*) *From two particular premisses no conclusion follows.*

The combinations of particular premisses can be the following:—II, OO, IO.

II. Neither of the premisses distributes a term. The middle term remaining undistributed, no conclusion follows.

OO. This combination is excluded by Rule 5.

IO. I distributes no term; O distributes one term—its predicate. Thus both the premisses distribute only one term. If there is to be any conclusion, that term must be the middle term. None of the extremes being distributed in the premisses, none must be distributed in the conclusion. If there is any conclusion, it must be I. This means that we have an affirmative conclusion, though one of the premisses is negative. This violates Rule 6.

(*b*) *If one of the premisses be particular, the conclusion must be particular.*

The possible combinations of the premisses are:—

AI, EI, AO, EO.

Of these EO is excluded by Rule 5.

AI. A distributes its subject, and I distributes neither the subject nor the predicate.

Thus both the premisses taken together distribute only one term. This term must be the middle term.

None of the extremes being distributed in the premisses, none must be distributed in the conclusion.

That is, the conclusion must be I, a particular.

Each of the remaining combinations, EI and AO, distributes two terms. One of these terms must be the middle term, and the other, one of the extremes. Only one extreme, therefore, can be distributed in the conclusion. One of the premisses in each combination being negative, the conclusion in either case is negative. The negative proposition that distributes but one term is O. Thus the conclusion from these combinations will be O, which, again, is a particular.

CHAPTER XIII

FIGURES AND MOODS

1. **WHAT IS MEANT BY FIGURE AND MOOD?**—The simple categorical syllogism consists of three propositions and contains three terms. Confining our attention to the propositions which compose the syllogism, we may enquire about the logical character of each of them. The major premiss may be A, E, I or O. Similarly, the minor premiss and the conclusion may be any of these four propositions. This will give rise to a number of syllogisms differing from one another—the difference being based on the logical character of the propositions that compose the syllogism. Such a difference is known as the difference of Mood. For instance, we have the Moods AAA, EAA, EIO, etc.

Suppose we have to express the Mood AAA. The Major premiss A contains Major and Middle Terms (P and M). Obviously this can be expressed in two ways; we may have All P is M or All M is P. Similarly, the Minor premiss may be expressed as All S is M or All M is S[1]. If we combine these premisses, we shall get four possible combinations:—

1. All M is P.
   All S is M.
2. All P is M.
   All S is M.
3. All M is P.
   All M is S.
4. All P is M.
   All M is S.

---

[1] The position of the terms in the conclusion is fixed—S is the subject, and P the predicate.

This difference arises from the position of the Middle Term. The Middle Term is present in both the premisses and in each must be either the subject or the predicate. Its possible positions are—

(*i*) Subject in both the premises.
(*ii*) Predicate in both the premises.
(*iii*) Subject in the major premiss and predicate in the minor.
(*iv*) Subject in the minor and predicate in the major.

This difference among syllogisms is known as the difference of Figure and it may be said that each syllogistic mood can be expressed in four figures.

These arrangements have received technical names as follows:—

Fig. I.

M—P
S—M
S—P

Fig. II.

P—M
S—M
S—P

Fig. III.

M—P
M—S
S—P

Fig. IV.

P—M
M—S
S—P

We have but four figures, but what is the total number of moods? The major can be one of the four propositions and the same is the case with the minor. This gives us sixteen combinations of premisses. Each of these combinations may have for its conclusion the proposition A, E, I or O. Thus we get 64 *possible moods*, each one of which can be expressed in four different ways.

A mere glance at some of these moods will show that they violate one syllogistic rule or another, and, so, are illegitimate. Our next problem is the determination of valid moods.

2. THE DETERMINATION OF VALID MOODS—How can we discriminate valid moods from the invalid ones? The simplest plan would be to write down all the sixty-four moods and to cancel those that violate some rule of the syllogism. This, however, is cumbersome and a more elegant plan is to examine the combinations of premisses and reject the invalid ones. Then we can find what conclusion will follow from each of the remaining combinations.

Take A as the major. There is nothing to restrict the combination with it of any proposition as minor. With A as major, we have the following combinations—AA, AE, AI, AO.

With E as major, we can have only an *affirmative* minor. The combinations are—EA, EI.

With I as major, we can have only a *universal* minor. The combinations are IA, IE.

If O is the major, only a *universal affirmative* minor is admissible. The combination is OA.

Thus, the complete list of valid combinations of premisses is—

AA, AE, AI, AO; EA, EI; IA, IE; OA.

If we get conclusions from these combinations in accordance with the syllogistic rules, we shall get the following moods—

AAA, (AAI), AEE, (AEO), AII, AOO; EAE, (EAO), EIO; IAI, (IEO); OAO.

The mood IEO is invalid, because the negative conclusion distributes its predicate (the Major Term), which is undistributed in the major premiss. It involves illicit process of the major. Cancelling this, we get *eleven legitimate moods.*

The moods AAI, AEO, EAO are called *Weakened Moods,* because in them we draw a conclusion weaker than the one that we are entitled to draw. They are also called *Subaltern moods,* because the conclusion in them is subalternate to the universal conclusion that is derivable from the premisses. It must be borne in mind that these moods are weakened moods only when a stronger conclusion can be drawn from their premisses. If, as sometimes happens, and as we shall see below, a particular conclusion is all that can be drawn from two universal premisses, the mood is not to be called Subaltern.

The same list of valid moods can be obtained in another way. Let us begin with the conclusion. The conclusion must be A, E, I or O. We have to determine the combinations of premisses that can give these conclusions.

(1) A. The conclusion being universal and affirmative, both the premisses *must be* universal affirmative. That is, the only mood in which A occurs as a conclusion is AAA.

(2) E. Both the premisses *must be* universal and one

must be negative. This gives us the moods AEE, EAE.

(3) I. Both the premisses *must be* affirmative and one *may be* particular. This gives us the moods AAI, AII, IAI.

(4) O. One of the premisses *must be* negative and one *may be* particular. The valid moods are AEO, EAO, AOO, OAO, EIO, (IEO).

The mood IEO must be cancelled for the reason given above.

3. Valid Moods in Particular Figures—If all these moods were valid in each of the figures, we might drop this part of the subject here. Examination shows, however, that they are not all valid in every figure. Take the mood IAI, for instance. Expressing it in all the four figures we get the following syllogisms—

I. Some M is P.
All S is M.
Some S is P.

II. Some P is M.
All S is M.
Some S is P.

III. Some M is P.
All M is S.
Some S is P.

IV. Some P is M.
All M is S.
Some S is P.

Now in the first two syllogisms, the Middle Term is not distributed in the premisses, and if we get a conclusion, it is by committing the fallacy of Undistributed Middle.

Thus the Mood IAI is invalid in Figures I and II. The third and fourth syllogisms violate no rules and, therefore, are valid. The mood IAI is valid only in Figures III and IV.

This raises a new question—How to find moods that are valid in the various figures?

Several ways of doing this are suggested. The final appeal is in every case to the General Rules of the Syllogism. When a mood expressed in a particular figure violates a rule, it is invalid in that figure; otherwise, it is valid. We may express each of the eleven moods in all the four figures (as IAI, above), and determine which of these are valid in each figure. Generally these moods are found by means of what are known as the Special Rules of the Figures.

4. SPECIAL RULES OF THE FOUR FIGURES.—The special rules can easily be found by examining the symbolic form of the figures.

(*i*) *Fig. I.*

M—P
S—M

S—P

The Major Term (P) is predicate, both in the conclusion and the major premiss. If it is distributed in the conclusion, it must be distributed in the major premiss, i.e., if the conclusion is negative, the major premiss must be negative. This means that, in these circumstances, the minor must be affirmative. If the conclusion is affirmative, both the premisses are affirmative. Therefore, in each case the minor is affirmative.

From this character of the minor, it follows that the minor does not distribute the middle term. The middle must, therefore, be distributed in the major premiss, which consequently must be universal.

The two special rules of the first figure are:—

1. The major premiss must be universal.
2. The minor premiss must be affirmative.

Rule I excludes the moods IAI, OAO; Rule 2 excludes the moods AEE, AEO, AOO. The remaining moods are valid.

We may as well proceed thus—From these special rules it follows that the valid combinations of premisses in this figure are AA, AI, EA, EI. The valid moods, therefore, are —AAA, AAI, AII, EAE, EAO, EIO.

(*ii*) Fig. II.

$$\begin{array}{c} P\text{—}M \\ \underline{S\text{—}M} \\ S\text{—}P \end{array}$$

M is predicate in both the premisses, and can be distributed only if one of the premisses is negative.

If one of the premisses must be negative, the conclusion must be negative.

The negative conclusion will distribute the major term. This must be distributed in the major premiss, where it occurs as the subject; therefore, the major must be universal.

The special rules are—

1. One premiss must be negative.
2. The major premiss must be universal.

Rule I invalidates moods AAA, AAI, AII, IAI; Rule 2 invalidates OAO (and IAI, again). The remaining moods are valid.

(*iii*) *Fig. III.*

$$\begin{array}{c} M—P \\ \underline{M—S} \\ S—P \end{array}$$

Here, as in the first figure, the position of the major term in the major premiss and the conclusion is the same, and, following the same line of argument, we can show that, in this figure also, the minor must be affirmative. The affirmative minor will not distribute its predicate, *i.e.*, the minor term. This term, therefore, must be undistributed in the conclusion. The conclusion consequently must be particular.

The special rules are—

(1) The minor premiss must be affirmative.

(2) The conclusion must be particular.

Rule I excludes AEE, AEO, AOO; Rule 2 excludes AAA, EAE, (AEE, again). The remaining moods are valid.

(*iv*) *Fig. IV.*

$$\begin{array}{c} P—M \\ \underline{M—S} \\ S—P \end{array}$$

The conclusion must be affirmative or negative. If it is affirmative, both the premisses are affirmative: if it is negative, one of the premisses is negative. We should find the consequences of

(*i*) negativeness of the conclusion,

(*ii*) affirmativeness of the major premiss,

(*iii*) affirmativeness of the minor premiss.

(1) If the conclusion is negative, the major premiss must be universal.

For thus alone can we distribute, in the major premiss, the term P, which is distributed in the conclusion.

(2) If the major premiss is affirmative, the minor must be universal.

For, if the minor were not universal, the middle term will remain undistributed.

(3) If the minor premiss is affirmative, the conclusion must be particular.

For, the minor premiss being affirmative, its predicate (S) will be undistributed. S must be undistributed in the conclusion, *i.e.*, the conclusion must be particular.

Rule 1 excludes OAO; Rule 2 excludes AII and AOO; Rule 3 excludes AAA and EAE. The remaining moods are valid.

Summing up, we can say that the valid moods in the four figures are the following:

Fig. I.	Fig. II	Fig. III.	Fig.IV.
AAA	AEE	AAI	AAI
[AAI]	[AEO]	AII	AEE
AII	AOO	EAO	[AEO]
EAE	EAE	EIO	EAO
[EAO]	[EAO]	IAI	EIO
EIO	EIO	OAO	IAI

In Fig. III, the conclusion O can be drawn from EI and

OA. When we get this conclusion from the premisses EA, we have a *strengthened mood, i.e.*, one of the premisses is stronger than it need be. Similarly, in Fig. IV, the conclusion I can be drawn from the premisses IA; when we draw it from AA, we have a strengthened mood.

A weakened mood is one in which the *conclusion* is weaker than it can be; a strengthened mood is one in which a *premiss* is stronger than it need be.

Thus there are twenty-four valid moods—six in each figure (a strange coincidence)—if we count as distinct moods, as we ought to, the same combination of propositions expressed in different figures. If we exclude the weakened moods, we have nineteen valid moods—four in Fig. I, four in Fig. II, six in Fig. III, and five in Fig. IV. The moods are designated by the names occurring in the following *Mnemonic lines*—

Barbara, Celarent, Darii, Ferioque, Prioris;
Cesare, Camestres, Festino, Baroco, Secundæ;
Tertia Darapti, Disamis, Datisi, Felapton,
Bocardo, Ferison habet; quarta insuper addit
Bramantip, Camenes, Dimaris, Fesapo, Fresison.

Each of these words contains three vowels which give us the mood in question.*

An examination of these lists shows that

A can be proved only in the first figure, and in a single mood.

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* The full meaning of the words will be indicated below in the chapter on Reduction.

E can be proved in every figure except the third, and
in four moods.
I can be proved in every figure except the second, and
in six moods.
O can be proved in every figure, and in eight moods.

Thus A is seen to be proved in the smallest, and O in the largest number of moods. These two propositions being contradictories, we may say that A is the most difficult proposition to establish and the easiest to disprove.

5. EXAMINATION OF A PARTICULAR MOOD—Sometimes we are required to say in what figures a particular mood is valid. It is no answer just to refer to the lists and say in which of them the mood in question does or does not occur. Nor is it desirable to appeal to the special rules of the figures and say that the mood does or does not conform to them. These rules are no ultimate principles of reasoning; they are only applications of the general rules about distribution of terms to specific cases. The ultimate appeal must always be to the general rules of the syllogism. When we are to determine in which of the figures a given mood is valid, the easiest plan is to express the mood in all the figures, and see where, if anywhere, a rule of the syllogism is violated. An example of this method was given while dealing with the mood IAI.

This, however, is not necessary. We may examine the mood, and by general reasoning answer the question. Let us deal with the moods AAA, OAO, and EIO.

(1) AAA.

The conclusion is All S is P. Here S is distributed, which must, therefore, be distributed in the minor premiss. The minor premiss distributes only the subject; therefore, it must be All S is M. As yet M is undistributed. It must be distributed in the major premiss, which, being A, distributes its subject only. The major, therefore, is All M is P.

Thus the syllogism assumes the form—

All M is P
All S is M
All S is P

This is obviously in the first figure.

(2) OAO.

The conclusion is some S is not P. The major term P distributed here must be distributed in the major premiss. This premiss, being O, distributes its predicate only. Therefore, the major premiss is—Some M is not P. M is so far undistributed; it must be distributed in the minor. The minor, however, can distribute only its subject, and so must be —All M is S. The syllogism that we get assumes the form—

Some M is not P
All M is S
Some M is not P

This is obviously a mood in the third figure.

(3) EIO.

The conclusion is Some S is not P. P, being distributed here, must be distributed in the major premiss. We have also to distribute the middle term. Thus the major and the middle term must be distributed in the premisses. The Major E distributes both these, and this *irrespective of their position.* Thus the major may be No P is M or No M is P. Our obligations being discharged, we are quite free about the position of terms in the minor. Thus, the position of terms in either premiss does not affect the validity of the argument. This means that the mood EIO is valid in all the figures.

[The mood EIO being valid in all the figures, the strengthened mood EAO also is valid in all.]

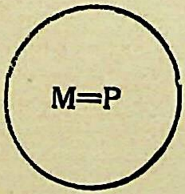
6. THE USE OF DIAGRAMS—Another way of determining whether a mood is legitimate *in a given figure* is by the use of Euler's circles. The figures sometimes are considerably complex, but the method is interesting and deserves notice. Let us take AAA (I), and EAE (II), as instances.

(*a*) AAA (I).

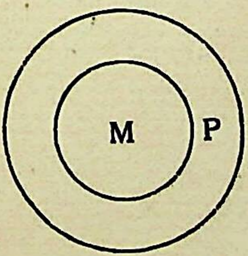
All M is P
All S is M
All S is P

The major can be represented by

(1)

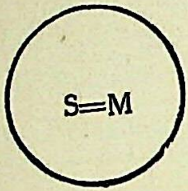


(2)

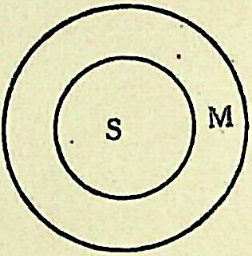


The minor can be represented by

(3)

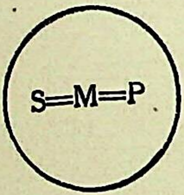


(4)

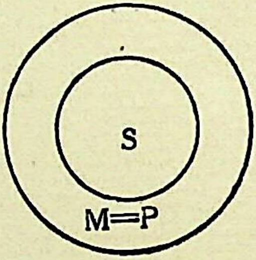


We can have four combinations of premisses as below:—

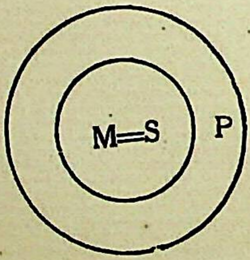
(1) and (3)



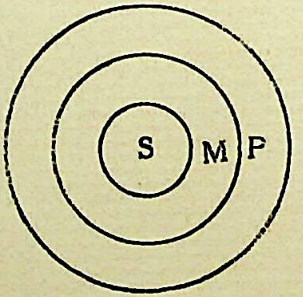
(1) and (4)



(2) and (3)



(2) and (4)



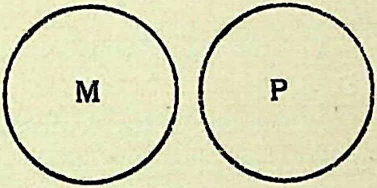
What is the relation that holds between S and P in all these cases? All S is P.

(*b*) EAE (II).

No P is M
All S is M
No S is P

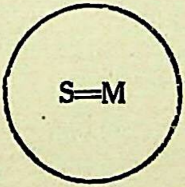
The major can be represented by

(1)

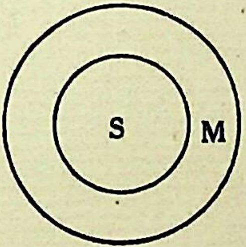


The minor can be represented by

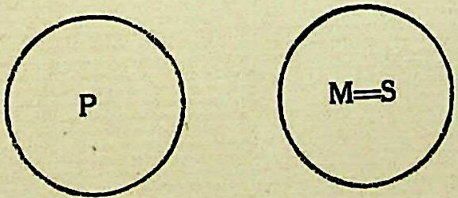
(2)



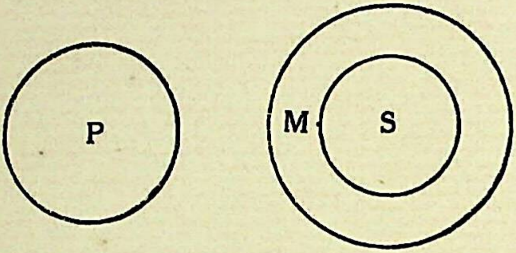
(3)



(1) and (2) give



(1) and (3) give



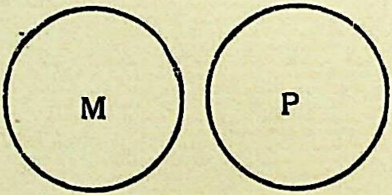
In either case S and P are mutually exclusive; i.e., No S is P.

Where one of the premisses is particular, the number of combinations is larger and the conclusion much less obvious.

Is the mood EAE valid in the 3rd figure?

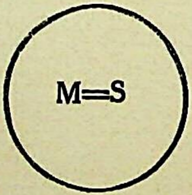
The major is—
No M is P.

(1)

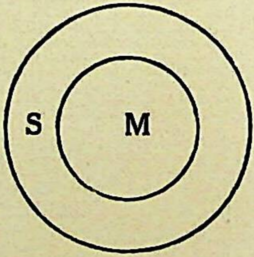


The minor is—
All M is S.

(2)

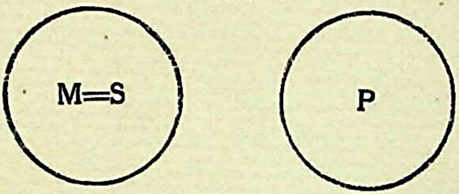


(3)



The combination of (1) and (2) is simple—

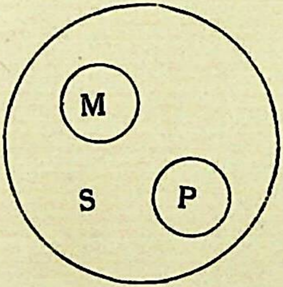
(*a*)



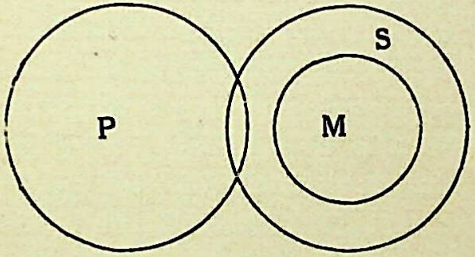
In the combination of (1) and (3), we know that M falls within S and outside P; but where shall we place P with reference to S?

It may be within S, may intersect S or may be altogether out of S. Thus—

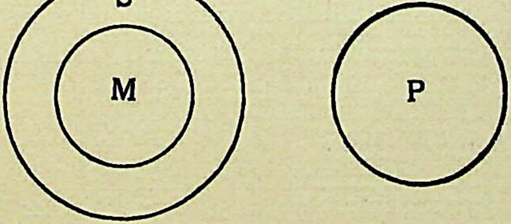
(*b*)



(*c*)



(*d*)



Now obviously, we are not entitled to say that No S is P; all that we can say is that some S is excluded from P; i.e., Some S is not P. The mood EAE is not valid in Fig. III; but the mood EAO is valid.

7. **Characteristics and Value of the Four Figures**—We shall close this chapter by considering the characteristics and value of the four figures.

Aristotle and his followers, the scholastic logicians, maintained that the first figure is the only cogent form of syllogistic reasoning, and that moods in other figures have to establish their validity by being reduced to the first figure. Kant and Hamilton among modern Logicians substantially agree with Aristotle and regard the last three figures as mere 'accidental modifications of the first.' Even those who maintain that the 2nd, 3rd and 4th figures are independent forms of reasoning are willing to accept the superiority of the first. Wherein this superiority lies will be obvious on considering the special features of this figure.

(1) The Dictum directly applies to the first figure, and to no other figure. The Dictum, as we have already seen, runs thus:—

Whatever can be affirmed or denied of a whole class, is validity affirmed or denied of what is included in that class.

To see the force of this point we may examine the mood EIO which happens to be valid in all the figures.

I.		II.	
	No M is P		No P is M
	Some S is M		Some S is M
	Some S is not P		Some S is not P

III. No M is P
Some M is S
Some S is not P

IV. No P is M
Some M is S
Some S is not P

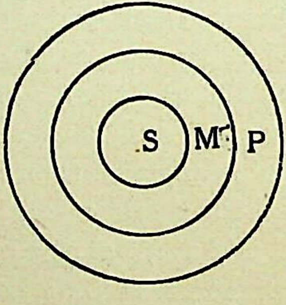
In the first figure, the major denies P of the whole class M, the minor affirms that 'Some S' is included in M; and, therefore, the conclusion denies P of 'Some S.' In the second figure, though the minor affirms that 'Some S' is included in M, the major does not deny P of M; rather, it denies M or P. Thus we have an inversion of thought in the major. In the third figure, P is denied of M in the major, but the minor instead of affirming the inclusion of 'Some S' within M, affirms the inclusion of 'Some M' within S. Here we have an inversion of thought in the minor. In the fourth figure we have neither P denied of M, nor 'Some S' included in M. We rather deny M of P, and include 'Some M' within S. This is a double inversion of thought.

(2) The first figure gives all sorts of conclusions and is the only figure in which A occurs as a conclusion.

The first part of this peculiarity is of no logical significance. If it were, the fourth figure would be more important than the 2nd or 3rd figure, inasmuch as it gives three kinds of conclusions against two of each of the other two figures. The second part of the peculiarity is full of significance. As Ueberweg remarks, '*Universal affirmative* conclusions have the *highest scientific value,* because they advance our knowledge in a positive manner and admit of reliable application to the individual.' Where possible, we try to find a universal positive connection between the subject and the predicate. A little consideration will show how all the sciences aim at making generalisations in the form of A. Mathematics tells us that 'All triangles have their angles equal to two right angles'; Physics, that 'All matter gravitates'; Law, that 'All stealing is crime'; Ethics, that 'The imperative of Duty is always supreme; medicine, that 'All malaria cases are curable by quinine'; and so on.

(3) The first is the only figure which is free from an inversion of thought. The subject and the predicate of the conclusion are subject and predicate in the premisses as well.

(4) It is in a mood in this figure (AAA), that the names Major, Middle and Minor appear to be appropriately given to the terms occurring in a Syllogism. If we express *Barbara* by diagrams, we have the following representation—



Here S has the smallest denotation; P, the largest; and M comes in between the two. In no mood of a figure other than the first do we find this relation illustrated.

If we now turn to the *second figure*, we find that it *proves only negative conclusions*. It is sometimes called the *exclusive* figure, because, by its means, we can exclude, one after another, the attributes that do *not* belong to a thing, till we retain only what belongs to it. It is mainly used in arguments intended to disprove the assertion of an adversary.

The *third figure* establishes only a particular conclusion. It is said to prove *exceptions* to a general rule. Its greatest service is that it guards us against overhasty generalisations. Arguments, in which the middle term is singular or definite in quantity naturally fall in this figure.

Socrates is a Philosopher.
Socrates is a Greek.
∴ Some Greek is a Philosopher.
Sixty per cent of students wear caps.
Sixty per cent of students keep their coats unbuttoned.
∴ ?

The *fourth figure* was not recognised by Aristotle. According to Aristotle, the form of the syllogism depends upon the different relations of terms based upon the principle of the wider including the narrower.

This gives but three positions—

(*a*) the middle is contained in one extreme and contains the other,

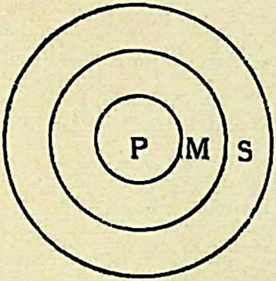
(*b*) the middle is the highest, i.e., predicate in both the premisses, (*c*) the middle is the lowest, i.e., subject in both the premisses.

These positions give us Figures I, II and III. When we say that Aristotle did not recognise the fourth figure, we do not imply that he altogether ignored the moods that are now assigned to the fourth figure. The syllogisms were present to his mind—only they were not assigned to a distinct figure. The fourth figure was recognised as a distinct figure by Galen in the second century, and is called after him. It was, however, not generally admitted in books on Logic before the beginning of the eleventh century, and even now its position is not quite secure.

Lambert's characterisation of the figures. Lambert, a German logician of the thirteenth century, thus expressed the uses of the four figures:—

'The first figure is suited to the discovery or proof of the properties of a thing, the second to the discovery or proof of the distinctions between things, the third to the discovery or proof of instances and exceptions, the fourth to the discovery or exclusion of the different species of a genus.'

On the use of the fourth figure mentioned by Lambert, Professor Welton observes: 'The relation of species and genus would be more satisfactorily established by a syllogism in the first figure, in which the name of the species is the minor, and the name of genus the major term, than by one in the fourth figure, in which the major term denotes the species and the minor term the genus.' We may illustrate this by considering *Bramantip.* In Euler's diagrams the relations of the terms are expressed thus—



The conclusion in Fig. IV is—Some S is P, whereas in Fig. I it would be—All P is S. (P is the species, and S the genus, as in the diagram.)

CHAPTER XIV

REDUCTION

1. *Direct Reduction*—We have seen that the mood EIO is valid in all the four figures. Let us express it in Fig. II.

No P is M
Some S is M
Some S is not P

Can we change this syllogism into some other figure? If we convert the major premiss, we get

No M is P
Some S is M
Some S is not P

This is a valid syllogism in Fig. I.

If we convert only the minor premiss, we get a syllogism in Fig. IV, and if we convert both the premisses, we get an argument in Fig. III.

This transformation of a syllogism into another, generally in a different figure, is called Reduction. In a narrower and generally accepted sense, *Reduction is the process of expressing in the first figure an argument given in one of the imperfect figures.*

Let us reduce some moods to see how this transformation can be effected.

(*a*) AEE (II)

All P is M
No S is M
No S is P

Our first impulse would perhaps be to convert the major. This, however, will reduce the quantity of the major and we shall be unable to get E as conclusion. The minor can be converted without loss of quantity and we can get the new premisses as

All P is M
No M is S

If we change their position (transpose them), we get the premisses arranged as in the first figure—

No M is S
All P is M
No P is S

The new conclusion when converted will give us the old conclusion. The steps necessary in the process are the following:—

(*i*) Conversion of the minor.
(*ii*) Transposition or mutation of the premisses.
(*iii*) Conversion of the new conclusion.

The mood given, then, can be reduced thus—

A	All P is M	No M is S (by conv.)	E
E	No S is M	All P is M	A
E	No S is P	No P is S	E
		=	
		No S is P (by conv.)	

The mood AEE of the second figure is reduced to the mood EAE of the first figure.

(*b*) EAE (II)

No P is M
All S is M
No S is P

Here all that is needed is the conversion of the major; thus—

E	No P is M	No M is P (by conversion)	E
A	All S is M	All S is M	A
E	No S is P	No S is P	E

The mood EAE of the second figure is reduced to the same mood of the first figure.

(*c*) IAI (III)

Some M is P
All M is S
Some S is P

If we simply convert the minor, we shall get two particular premisses. We should transpose the premisses and convert the given major.

Thus—

I	Some M is P	All M is S	A
A	All M is S	Some P is M (by conv.)	I
I	Some S is P	Some P is S	I

Some P is S
=
Some S is P
(by conversion)

IAI in Figure III is reduced to AII in Fig. I.

(*d*) AAI (IV)

A	All P is M	All M is S	A
A	All M is S	All P is M	A
I	Some S is P	All P is S	A
		=	
		Some S is P	
		(by conversion)	

(*e*) AOO (II)

All P is M
Some S is not M
Some S is not P

The conversion of the major will give us two particulars. The proposition E suffers no loss in quantity by conversion. Can we first transform the major into E?

This can be done by obverting it. Thus—

All P is M=No P is non-M.

'No P is non-M' is convertible into—No non-M is P.

If we retain the minor as it is, we shall have four terms. By obverting the minor, we get over this difficulty, and the two premisses that we can thus have are—

No non-M is P	E
Some S is non-M	I
Some S is not P	O

The new mood is EIO.

The middle term in the new syllogism is non-M. This, however, does not affect the reasoning. Our premisses are the same as before; only they are now in a new form. This process is known as Direct or Ostensive Reduction.

2. *The Mnemonic Lines and their Explanation*—The valid moods, except the weakened or subaltern ones, are all given in the following hexametric verses—

Barbara, Celarent, Darii, Ferioque, Prioris;
Cesare, Camestres, Festino, Baroco, Secundæ;
Tertia Darapti, Disamis, Datisi, Felapton,
Bocardo, Ferison habet, quarta insuper addit
Bramantip, Camenes, Dimaris, Fesapo, Fresison.

The names occurring in the lines also indicate the process of reducing moods from an imperfect figure to the first figure. In fact, if we understand the significance of the letters occurring in them, the process of Reduction becomes quite mechanical.

What do these letters signify?

The vowels in the words give us the syllogism. Thus, Darapti means the mood AII in the third figure.

The first letter of the imperfect mood indicates the mood to which it is to be reduced. The old and the new mood have the same initial letter.

The letter *s*, in the middle of a word, indicates that the proposition preceding it is to be converted simply.

Where *s* occurs at the end of a word, it indicates that the conclusion of the new syllogism will have to be simply converted before it can assume the form of the original conclusion.

The letter *p* indicates that the proposition preceding it is to be converted *per accidens.*

m indicates that the premisses are to be transposed.

c shows that the mood cannot be directly reduced. (The ancient logicians employed only conversion and transposition for the purpose of reduction. We have seen that the mood Baroco can be directly reduced, if we employ obversion besides conversion and transposition. Bocardo also can similarly be reduced directly.)

The remaining letters are meaningless.

We have reduced the moods AEE(II), EAE(II), IAI (III), and AAI(IV). Their names, as occurring in the mnemonic lines, are *Camestres, Cesare, Disamis* and *Bramantip.*

What help can we get from these names?

(1) Camestres.

(*i*) *C* shows that the new mood will be Celarent.

(*ii*) *m* shows that the premisses are to be transposed.

(*iii*) *s* (in the middle) shows that the minor premiss E is to be simply converted.

(*iv*) *s* (at the end) shows that the new conclusion will have to be simply converted to assume the form of the original conclusion.

An examination of the process of Reduction shows that all this has been done.

(2) Disamis.

Here we are to (1) convert the major, (2) transpose the premisses, (3) convert the new conclusion. The new syllogism will be Darii.

3. *Indirect Reduction*—The process of Reduction described in the first section of this chapter is known as Direct or Ostensive Reduction. It aims at showing that by transforming the premisses we can get a syllogism, in the first figure, with our original conclusion, or with a conclusion from which the original conclusion will necessarily follow. The transformation of the premisses consists in simple transposition or an immediate inference or both. Now Aristotle did not admit any immediate inference except Conversion. With this limitation, the moods Baroco and Bocardo cannot be reduced directly. To reduce these moods, another process known as *Indirect Reduction* or Reduction *per impossibile* is used. This is the process of proving the validity of a mood by showing that to suppose it to be invalid will lead to a contradiction. This process is applicable to all imperfect moods, but is generally used to reduce Baroco and Bocardo.

To indicate its nature, we shall reduce *Baroco*.

This is a mood in Fig. II.

All P is M
Some S is not M
Some S is not P

Our business is to show that if the premisses are accepted as true, the conclusion must also be accepted.

If this conclusion is false, its contradictory—All S is P—

must be true. Combining this with the original major, we get—

All P is M
All S is P

These give the conclusion 'All S is M' (in Barbara).

Now the conclusion contradicts the original minor—Some S is not M. Only one of these two can be true. The proposition 'Some S is not M' is assumed to be true; therefore, 'All S is M' is false. The falsity of this must be due either to a flaw in reasoning or to some falsity in the premisses of the argument. The argument being in the first figure is flawless. The defect, therefore, lies with the premisses. Of these, one—All P is M—is given as true; therefore, the other premiss must be false. We find then that 'All S is P' is false. If this is false, its contradictory—Some S is not P—must be true. This is what we wanted to show.

4. *The Value of Reduction*—What is the value of Reduction? Is it an essential part of the doctrine of the syllogism? The object of Reduction is to make sure that arguments given in the imperfect figures are valid. But do these moods require any validation? If we accept the *Dictum de omni et nullo* as the ultimate principle of all reasoning, the moods in the second, third and fourth figures must be treated as imperfect. The dictum does not directly apply to them, and in order to vindicate their claim to validity they must show that they do not rebel against the authority of the dictum. Some Logicians deny that figures 2, 3 and 4 are genuine and original forms of rea-

soning. Hamilton thinks that these three figures are virtually identical with the first, being merely 'accidental modifications' of it. If we adopt this view, Reduction becomes an essential part of the doctrine of the syllogism. Professor Fowler is of the opinion that though the moods in these three figures do not offend against any syllogistic rule, we do not positively know that they are valid, because we do not possess an axiomatic principle like the Dictum to which they conform. 'Their validity can be proved by showing that their conclusion can be obtained from equivalent premisses in the first figure.'

On the other hand, some Logicians refuse to accept the Dictum as the ultimate principle of all syllogistic reasoning, and the first figure as the perfect figure. They hold that other figures (specially the second and the third) represent independent types of reasoning, and are on a level with the first. Independent Dicta for the so-called imperfect figures are given,[1] and Reduction is declared to be *unnecessary*, for the simple reason that moods in these figures, being perfectly valid, do not stand in need of any validation.

It is sometimes said that though moods in the imperfect figures are valid, the reasoning is not quite so natural as in the first figure. This also may be denied. In fact, it will appear that some arguments appear more natural in these forms than in the first figure. Take the following syllogism—

---

[1] These Dicta are the following:—

Fig. II. *Dictum de diverso.* If one term contained in and another excluded from, a third term, they are mutually excluded. (Lambert.)

Fig. III. *Dictum de exemplo.* Two terms which contain a common part, partly agree, or if one contains a part, which the other does not, they partly differ. (Lambert.)

Fig. IV. *Dictum de reciproco.* If a term be included in a second term which is excluded from a third, then the third is excluded from the first: if a term be included in (or excluded from) a second term which is included in a third, then a part of the third is included in (or excluded from) the first. (Ray.)

All cultured persons enjoy music.
Gobind does not enjoy music.
Therefore, Gobind is not a cultured person.

This is AEE in the second figure. Reduced to EAE of the first figure, the argument will read thus—

No one who enjoys music is Gobind.
All cultured persons enjoy music.
Therefore, No cultured person is Gobind.

No one can say that the argument when reduced becomes more natural.

Again, take the following in the third figure—

Plato is a Philosopher.
Plato is a Greek.
Therefore, Some Greek is a Philosopher.

In order to reduce it to the first figure, we must change the minor into 'Some Greek is Plato'. It is obvious that 'Plato is a Greek' is a more natural statement than 'Some Greek is Plato.'

What then is the place of Reduction in the Logical Doctrine? The answer to this question will mainly depend upon our view of the status of the second, third and fourth figures. We have seen that the first figure is not the only genuine and ultimate form of reasoning; we have also seen that there are cases when reasoning in other figures appears to be more natural than in this figure. However, when all this is said, it remains true that, on the whole, reasonings in the first figure are more straightforward, and though arguments expressed in the imperfect figures gain nothing in validity by being reduced to the first figure, they do, very often, become more transparent in the new form.

As a logical exercise, Reduction possesses a great value One of the main objects of the study of Logic is to train us in the habits of consecutive thought, to make us rigidly self-consistent in our argument. Reduction is an admirable thought-compelling exercise, leading the mind from step to step in a continuous process, and making it find out the means to realise a given end. Further, by showing the equivalence of the various forms of reasoning, it impresses upon our mind the all-important truth that ultimately all reasoning is based on the same Laws of Thought.

CHAPTER XV

ABBREVIATED AND COMPOUND SYLLOGISMS

1. *The Enthymeme*—Aristotle spoke of the Enthymeme as an *incomplete syllogism*. By this he meant to emphasize the fact that the conclusion in this syllogism was not absolutely certain but only probable. The incompleteness lay in the *proof* of the conclusion. The reason of this defect was that the major was a statement *nearly, but not quite, universal*. For example—

Most of the students in the college wear caps.
Rajendra is a student in the college.
Therefore, Rajendra (probably) wears a cap.

The essence of the ordinary syllogism lies in the necessity with which the conclusion follows from the premisses. An argument like the one given above furnishes only a probable conclusion, and, hence, if called a syllogism at all, must be regarded as an imperfect syllogism. Later Logicians misunderstood the significance of the word 'incomplete' employed in Aristotle's characterisation of such arguments, and supposed that the incompleteness lay in the *expression*. Modern Logicians define the Enthymeme as *a syllogism in which either a premiss or the conclusion is understood but not expressed*. Such arguments are very common in everyday life, particularly when they are fallacious. In fact, one of the main causes why so many fallacies remain undetected is that the fallacious arguments are not fully expressed.

All material substances have weight.
Air is a material substance.
Therefore, Air has weight.

If, in this syllogism, we suppress one of the premisses or the conclusion, we get the following elliptical syllogisms:—

(*i*) Air is a material substance, and, therefore, has weight.

(*ii*) All material substances have weight, and, therefore, air has weight.

(*iii*) All material substances have weight, and air is a material substance.

In the first the major is omitted. This is the commonest form of the enthymeme and is said to be of the first order. The second omits the minor and is said to be of the second order. The third omitting the conclusion is said to be of the third order.

2. *The Epicheirema*—Sometimes one or both of the premisses in an argument are supported by a reason. Such an argument is called an Epicheirema. If one of the premisses is supported by a reason, the epicheirema is *Single*: if both the premisses are so supported, we have a *Double* epicheirema. If the supporting reason is itself supported by a reason, we have a *Complex* epicheirema.

Illustrations:—

(*i*) *Single*:—

All men are to be treated as ends, because they are rational creatures;

Slaves are men;
Therefore, slaves are to be treated as ends.

(*ii*) *Double*:—

All men are mortal, for they are animals;
Socrates is a man, for rational bipeds are men;
Therefore, Socrates is mortal.

(Carveth Read.)

All Malays are cruel, because all Savages are.
All the aboriginal inhabitants of Singapore are Malays, because all the natives of that part of Asia are;
Therefore, all the natives of Singapore are cruel.

(Welton.)

(*iii*) *Complex*:—

All A is B, because it is K, because it is R.
All C is A.
All C is B.

The Epicheirema is not a single syllogism, but an abbreviated chain of reasoning or *Poly-Syllogism*. This will be obvious if we analyse the argument. The first Epicheirema given above can be analysed thus:—

(1) (All rational creatures are to be treated as ends.)
All men are rational creatures.
∴ All men are to be treated as ends.

(2) All men are to be treated as ends,
Slaves are men,
∴ Slaves are to be treated as ends.

Here we have two syllogisms so related that the conclusion of the one becomes a premiss in the other. Of the syllogisms having this kind of relation, the first is called a *Prosyllogism*, and the second, an *Episyllogism*.

The second Epicheirema given above can be analysed thus:—

(*a*) (All animals are mortal,)
All men are animals,
∴ All men are mortal.
(*b*) All rational bipeds are men,
(Socrates is a rational biped.)
∴ Socrates is a man.
(*c*) All men are mortal,
Socrates is a man,
∴ Socrates is mortal.

Here both (*a*) and (*b*) are Prosyllogisms with respect to (*c*). The syllogisms (*a*) and (*b*) are Enthymemes. If we emphasise this feature of the argument, we can define the Epicheirema thus:—

An Epicheirema is a Poly-Syllogism with one or more Prosyllogisms incompletely expressed.

The progress of thought in this argument is essentially *regressive*: we pass from the Episyllogism to the Prosyllogisms on which it depends; from the conclusion to the principles which support it. In this respect, the Epicheirema is contrasted with another form of the Poly-Syllogism known as the Sorites.

3. *The Sorites*—The sorites is a chain argument in which all conclusions save the final one are suppressed. The following may be taken as an instance:—

All A is B,
All B is C,
All C is D,
All D is E,
All E is F,
All A is F.

If we invert the order of the premisses, we get—

All E is F,
All D is E,
All C is D,
All B is C,
All A is B,
All A is F.

The two forms are known as Aristotelian and Goclenian Sorites respectively.

The structure of the two forms shows that in the Aristotelian form the predicate of each premiss is the subject of the premiss that follows, whereas in the Goclenian form the subject of each premiss becomes predicate in the next. In the Aristotelian form, the subject of the conclusion is the subject of the first premiss and the predicate of the conclusion is the predicate of the last premiss. In the Goclenian form the subject of the conclusion is the subject of the last premiss, and the predicate, the predicate of the first premiss. The Sorites can be defined by reference to this feature of its structure. We can analyse the arguments into their constituent syllogisms thus—

(*a*) Analysis of the Goclenian Sorites.

(1) All E is F
All D is E
All D is F

(2) (All D is F)
All C is D
All C is F

(3) (All C is F)
All B is C
All B is F

(4) (All B is F)
All A is B
All A is F

(*b*) Analysis of the Aristotelian Sorities.

(1) All B is C
All A is B
All A is C

(2) All C is D
(All A is C)
All A is D

(3) All D is E
(All A is D)
All A is E

(4) All E is F
(All A is E)
All A is F

In both the forms, except in the very first syllogism, one of the premisses is suppressed. *The premiss suppressed is minor in the Aristotelian and major in the Goclenian Sorites.*

Some logicians distinguish the two forms by calling them Progressive and Regressive Sorites. This is quite illegitimate. The progress of thought in both cases is *forwards;* we move from Prosyllogisms to Episyllogisms, from grounds to conclusions. Both the forms agree in this respect, and are contrasted with the Epicheirema which is essentially regressive in character.

What then, it may be asked, is the difference between the two forms and why should both be retained? There is no difference of character between them. The only differences that we have noted are these two—

(1) In the one, the subject of the conclusion appears in the first premiss and the predicate in the last, whereas, in the other, the reverse is the case.

(2) In the one the premiss that is suppressed is the minor, whereas, in the other, it is the major.

These differences are of no logical significance. Further, we want to get the conclusion out of all the premisses taken together, and the *order* in which the premisses are given is of no importance. The premisses being the same, we have really only one form of the Sorites, and that, the Goclenian; for in it the premisses are arranged in the first figure, whereas in the Aristotelian form they have to be so arranged.

Rules of the Sorites. In the examples that we have selected, the premisses are all universal and affirmative. Is this essential? No; we can have negative or particular premisses; but a little thought will show that in this respect our choice is very limited. If a premiss is negative or particular, it imparts its character to the conclusion of the syllogism in which it occurs. The conclusion, again, becomes a premiss in the next syllogism. If we have more than one negative or particular premiss, we shall, in expanding the argument, come across a syllogism with two negative or two particular premisses. As two such premisses yield no conclusion, we can have only one negative and one particular premiss in a Sorites. Our next point is to find which of the premisses can be particular or negative. First consider the case of a negative premiss. Whenever any of the premisses is negative, the final conclusion in the Sorites will be negative, and, as such, will distribute its predicate. This term, the final major, must be distributed in the premisses. Where does it occur? It occurs in the last premiss in the Aristotelian and in the first premiss in the Goclenian Sorites. Thus we find that the only premiss that can be negative in a Sorites must be the last in the Aristotelian, and the first in the Goclenian Sorites.

Now what about the particular premiss? Expanding the arguments we found that all the resulting syllogisms are in the first figure. The Sorites must, therefore, be governed by the special rules of that figure. In the first figure, the major is always universal. The expansion of the Sorites shows that in the Aristotelian form, all premisses except the first become major, and in the Goclenian form all premisses except the first become minor. It follows that in the Aristotelian form, only the first premiss can be particular. In the Goclenian form, if any premiss but the last were particular, the conclusion of the syllogism in which it occurred would be particular, and, as that would be the major premiss in the succeeding syllogism, we should be committing the fallacy of undistributed middle. Thus, if we have any particular premiss in the Sorites, it must be the first in the Aristotelian, and the last in the Goclenian form.

Thus we find the following special rules of the Sorites:—

(*a*) Aristotelian Sorites—
  (1) The first premiss alone can be particular.
  (2) The last premiss alone can be negative.

(*b*) Goclenian Sorites—
  (1) The first premiss alone can be negative.
  (2) The last premiss alone can be particular.

Irregular Sorites. The above rules assume that the Sorites is entirely in the first figure. It may sometimes happen that all the constituent syllogisms are not in this figure. When this happens, the Sorites is said to be Irregular. The following is an instance—

All A is B,
All B is C,
All D is C,
All E is D,
All E is F,
?

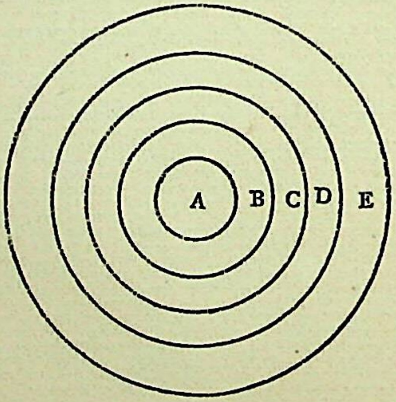
Diagrammatic representation of the Sorites. Take the following Sorites—

All A is B,
All B is C,
All C is D,
All D is E,
All A is E.

If the propositions that compose the Sorites are interpreted in extension, we have the following relations—

A is included in B,
B is included in C,
C is included in D,
D is included in E,
∴ A is included in E.

The argument can be represented by diagrams thus—



It is obvious that, in the Aristotelian form of the Sorites, we advance from terms of smaller extension to terms of greater extension; whereas, in the other type, the movement is in the contrary direction.

CHAPTER XVI

COMPLEX SYLLOGISMS

The syllogisms that have hitherto been considered consist of categorical propositions. But propositions may be complex and there is nothing to prevent their appearance in arguments. As a matter of fact, our arguments often have complex premisses and sometimes complex conclusions. Such syllogisms are called Complex Syllogisms.

Complex Syllogisms are of three kinds—

(*a*) Hypothetical or Conjunctive Syllogisms.

(*b*) Disjunctive Syllogisms.

(*c*) Hypothetical-Disjunctive Syllogisms or Dilemmas.

We shall briefly characterise and illustrate these forms.

1. HYPOTHETICAL SYLLOGISMS. These are of two kinds—Pure and Mixed. In the Pure Hypotheticals, both the premisses and the conclusion are hypothetical propositions. As—

If C is D, E is F;
If A is B, C is D;
If A is B, E is F.

If the road is muddy, walking is dull business;
If it rains, the road is muddy;
∴ If it rains, walking is dull business.

In the mixed hypotheticals, the major premiss is hypothetical, but the minor and the conclusion are both categorical.

As—

If A is B, C is D;
A is B;
C is D.

If the College closes for tomorrow, we shall go to the river;
The College closes for tomorrow;
∴ We shall go to the river.

The Pure Hypothetical Syllogisms are of little value. They do not give us anything definite in the conclusion. In the example given above, we do not know whether the rain actually falls and walking is dull business. As Carveth Read remarks, 'the purpose of the Hypothetical Syllogism is to get rid of the conditional element, to pass from doubt to certainty and obtain a decisive Categorical Conclusion.' This purpose is not fulfilled, if the constituent propositions are all hypothetical. Generally, therefore, when we speak of the Hypothetical Syllogism, we mean the Mixed Hypothetical.

Consider the Mixed Hypothetical, given above—

If A is B, C is D;
A is B;
C is D.

Here the minor affirms the *antecedent* of the major. The minor can, however, deny the *antecedent*, or affirm or deny the *consequent*. Thus there can be *four* possible combinations of premisses—

(1) If A is B, C is D
A is B

(2) If A is B, C is D
A is not B

(3) If A is B, C is D
C is D

(4) If A is B, C is D
C is not D

Of these combinations, Nos. (1) and (4) give a conclusion: whereas Nos. (2) and (3) give no conclusion. In (1), the minor affirms the condition (A is B), on which a result (C is D) follows: the conclusion, therefore, must affirm that consequent—C is D. In (4), the consequent is denied in the minor, and the ground must be denied in the conclusion.

If the minor affirms the antecedent of the major, we have a *Constructive* Hypothetical Syllogism, also called *Modus Ponens;* if the minor denies the consequent of the major, we have a *Destructive* Hypothetical Syllogism, otherwise called *Modus Tollens.* The character of the Hypothetical Syllogism has nothing to do with the quality of the antecedent or the consequent. Even if the denial of the consequent and the conclusion are both affirmative, the syllogism is Destructive. As—

If the rain does not fall, the road is not muddy;
The road is muddy;
Therefore, the rain has fallen.

A little consideration will show that the combinations (2) and (3) give no conclusion. If we deny the antecedent, that does not entitle us to deny the consequent, for the latter may be true for some other reason; similarly, if we affirm the consequent, we may not be able to affirm the antecedent.

A concrete instance will make this clear. The major affirms that if a man takes a large dose of opium, he will die. Now, obviously, if in the minor we have a definite case of Jones having taken a large dose of opium, we can infer that he will die. And if Jones does not die, it is a reasonable inference that he has not taken a large dose of opium. If, however, we are assured that Jones has not taken a large dose of opium, we have no right to affirm that he will not die, nor will the fact of his death be a proof that he did take a large dose of opium. The reason is that starvation, old age, suffocation, foul play and so many other things may as well cause his death.

If we reduce the Hypothetical Syllogism to a Categorical, we shall see why the denial of the antecedent and the affirmation of the consequent give no conclusion. The Hypothetical premiss—If A is B, C is D—can be changed into—All cases of A being B are cases of C being D, or All AB is CD. The minor premiss 'A is B' can be changed into—this is AB.

The combinations of premisses and their conclusions will be as follows:—

(1) All AB is CD
This is AB
This is CD

(2) All AB is CD
This is not AB.
×

(3) All AB is CD
This is CD
×

(4) All AB is CD
This is not CD
This is not AB

To have a conclusion in (2) will involve Illicit Process of the Major, and to have a conclusion in (3) will involve the fallacy of the Undistributed Middle.

Thus we get the following principle of the Hypothetical Syllogism—

In the Hypothetical Syllogism, the minor should affirm the antecedent or deny the consequent of the major premiss.

2. THE DISJUNCTIVE SYLLOGISM. In the Disjunctive Syllogism, the major premiss is Disjunctive and the minor and the conclusion are both Categorical.

The major may be expressed in the following ways—

A is either B or C.

Either A or B is C.

Either A is B or C is D.

Either A or B. (A and B here stand for propositions.)

Concrete instances—

This man is either the manager of a bank or a police officer.

Either Gopal or Krishna is the present Head Master of the School.

Either the College is closed for tomorrow, or the peon is not well-informed.

Taking 'Either A is B or C is D' as the standard form, what can we have as the minor? Each of the two alternatives may be affirmed or denied; i.e., we have four possible minors—

(1) A is B.
(2) A is not B.
(3) C is D.
(4) C is not D.

Now, which of the combinations of premisses that we can get are legitimate? This depends upon the interpretation that we put upon the disjunctive major. What do we mean when we say A is B or C? Are these mutually exclusive alternatives or can A be *both* B and C? In ordinary language, we often use disjunctive propositions in which the alternatives are mutually exclusive, but there are also cases in which the alternatives do not exclude each other. Take the following instances—

(*i*) Karam Chand has either failed or passed.

(*ii*) In the inter-group tournament, either the Philosophers or the Mathematicians win.

(*iii*) Rama is Secretary either of the Historical Club or of the Literary Association.

(*iv*) Jones has been reading very good text books or has been well taught.

Now in (*i*), obviously, the alternatives are mutually exclusive; no one can both fail and pass. In (*ii*), if the competing teams are the Philosophers and the Mathematicians, and if somebody does win, it must be only one group. In (*iii*), perhaps all that we know is that Rama does a Secretary's work; what is there to prevent his being Secretary of both the Associations? And, again, it may happen that Jones has had the advantage of reading good books and likewise of being well taught.

Common language, therefore, vacillates between two positions; the alternatives sometimes do and sometimes do not exclude each other. Some logicians are of the opinion that though in ordinary language the disjunctive proposition does not necessarily give us exclusive alternatives, in Logic we should understand them to be mutually exclusive. Others are of the opinion that, in order to be of practical utility, Logic should depart from ordinary language as little as possible. According to these, a conclusion will follow only if one of the alternatives is denied. Thus—

(1) Either A is B or C is D;
A is B;
×

(2) Either A is B or C is D;
A is not B;
C is D.

(3) Either A is B or C is D;
C is D;
×

(4) Either A is B or C is D;
C is not D;
A is B.

Thus we get the following canon of the Disjunctive Syllogism—

In the Disjunctive Syllogism, the minor should deny one of the alternatives of the major.

We have supposed that the major has only two alternatives. This is what generally happens, but it is not essential. We may have any number of alternatives and in the minor deny one or more than one. In consequence, it is not necessary that the conclusion be a Categorical Proposition. For instance, we have the following Disjunctive Syllogisms—

(*i*) A is either B or C or D;
A is not B;
A is either C or D.

(*ii*) A is either B or C or D or E;
A is neither B nor C;
A is either D or E.

The fuller statement of the canon of Disjunctive Syllogism is the following—

The minor denies one member or more of the alternation and the conclusion affirms the other member or members.

The Disjunctive Syllogism can be resolved into the Hypothetical form by transforming the Disjunctive major into an Hypothetical proposition. According to the interpretation that we have adopted, Either A is B or C is D is equivalent to—

(*a*) If A is not B, C is D, (*b*) If C is not D, A is B.

If we apply the canon of the Hypothetical Syllogism, we see that a conclusion follows only when the minor is (*i*) A is not B or (*ii*) C is not D.

3. THE DILEMMA. The Dilemma is a Hypothetical-Disjunctive Syllogism in which the major is a hypothetical with two antecedents or consequents or both, and the minor a disjunctive proposition.

The following are the standard forms—

(1) If A is B, C is D; if E is F, G is H;
Either A is B, or E is F;

Therefore, Either C is D, or G is H;

(2) If A is B, C is D; if E is F, G is H;
Either C is not D, or G is not H;
Therefore, Either A is not B, or E is not F.

The minor affirms the antecedents or denies the consequents, disjunctively. If the consequents are affirmed or antecedents denied, no conclusion follows. The principle of the Dilemma is the same as that of the Hypothetical Syllogism, and, for this reason, some logicians call it a Compound Hypothetical Syllogism.

When the minor affirms the antecedents (disjunctively), the Dilemma is called *Constructive;* when the minor denies the consequents (disjunctively), the Dilemma is *Destructive.* In either case, the conclusion itself is a Disjunctive proposition. This is the standard form of the Dilemma. It may happen, however, that both the antecedents or both the consequents are identical. The Dilemma given above would then read thus—

(3) (If A is B, C is D; if A is B, G is H;)
If A is B, C is D *and* G is H;
Either C is not D, or G is not H;
Therefore, A is not B.

(4) (If A is B, C is D; if E is F, C is D;)
If A is B *or* E is F, C is D;
Either A is B, or E is F;
Therefore, C is D.

Here the conclusions are Categorical. Therefore, the

Dilemmas are called Simple in contrast with the two original forms which are called Complex.

The simple Dilemmas are really derivative forms. If we treat them as independent forms, we have the following *four kinds of the Dilemma*:

(1) *Simple Constructive—*
If either A or B, then C;
Either A or B;
C.

'Whether a man acts in accordance with his own judgment or is guided by the opinion of others, his action will be criticised.

'But either he acts in accordance with his own judgment or he is guided by the opinion of others.

'In any case, his action will be criticised.'

(*Boyce Gibson.*)

Troops with a river behind them have sometimes been placed in a Dilemma none the less painful because it is simple. 'If they stand their ground, they die by the sword of the enemy; if they retreat, they die—by the flood; but they must either stand, or retreat; therefore, they must die.'

(*Joseph.*)

(2) *Simple Destructive—*
If A, then both B and C;
Either not B *or* not C;
Not A.

If I join College, I must pay College fees as well as spend money on books.

Either I cannot pay College fees, or cannot spend money on books.

Therefore, I cannot join College.

(3) *Complex Constructive*—

If A, then B; if C, then D;
Either A or C;
Either B or D.

If I go to the gymnasium, I shall develop my body; if I go to the Town Hall, I shall hear a lecture.

Either I go to the gymnasium, or to the Town Hall.

Therefore, Either I develop my body, or hear a lecture.

(4) *Complex Destructive*—

If A, then B; if C, then D;
Either not B, or not D;
Either not A, or not C.

'If he were clever, he would see his mistake; and if he were candid, he would acknowledge it.

'Either he does not see his mistake or he does not acknowledge it.

'Either he is not clever, or he is not candid.'

(*Stock.*)

Trilemma and Polylemma. In the Dilemma, the number of antecedents or consequents in the major does not exceed two. An argument containing three hypothetical propositions in the major premiss is called a Trilemma. If these propositions are more than three, the argument is called a Polylemma. Often, however, the Dilemma is understood to cover these cases as well.

Example of a Trilemma—

If A is B, C is D; if E is F, G is H; if K is L, M is N;
Either A is B, or E is F, or K is L;
∴ Either C is D, or G is H, or M is N.

Rebuttal of a Dilemma. A Dilemma is said to be rebutted when we bring, in opposition to it, a Counter-Dilemma that seems to be equally cogent and appears to prove an opposite conclusion. As an example, we may give the story of the Athenian mother who urged her son not to enter upon public life.

The mother said:—

'If you say what is just, men will hate you; if you say what is unjust, the gods will hate you. You must say either what is just or what is unjust. Therefore, you will be hated.'

The son replied:—

'If I say what is just, the gods will love me; if I say what is unjust, men will love me. I must say either what is just or what is unjust. Therefore, I shall be loved.'

As another instance, take the following—

'If a man marries, he is happy—because he gets a companion; if a man does not marry, he is happy—because he is free from obligations.

Now a man either marries or does not marry.

Therefore, (in either case) a man is happy.'

This may be rebutted by the following Counter-Dilemma—

'If a man marries, he is unhappy, because he has obligations; if a man does not marry, he is unhappy, because he is without a companion.

Now a man either marries or does not marry.

Therefore, (in either case) a man is unhappy.'

A good dilemma with a rebuttal is given in the story of Protagoras and Euthlus, known as the *Litigiosus*. Protagoras trained Euthlus as a lawyer on the condition that half the fee be paid in the beginning and the other half when Euthlus won his first case. When the period of training was over, Euthlus gave up the idea of practising as an advocate. Protagoras, feeling that he was unfairly dealt with, brought a suit against him, and outside the court room addressed Euthlus thus—"Most foolish young man, you will have to pay me my fee. If I win the case, the court awards me the money; if I lose, you will pay according to our contract.' Euthlus, who had read with Protagoras to some purpose, answered—'Most sapient master, in no case shall I pay you. If you win the case, the conditions of our contract are not fulfilled; if I win, the court absolves me from any obligation to pay.'

What is the solution of the difficulty? Professor Welton thinks that 'as Euthlus had until then won no case, the condition of the bargain was not fulfilled, and the judges should have decided in his favour. It was then open to Protagoras to bring a fresh suit, when the judgment must have gone against Euthlus.'

But why should the judges decide at all in favour of one or the other of the disputants? As Boyce Gibson puts it, 'there was no case to be judged, as the condition that alone could have justified an appeal to law over the matter had never been fulfilled. And the judges' refusal to decide anything cannot be taken as a verdict in favour of Euthlus. Their verdict is not on the case, but on the nature of the conditions requisite to constitute a case.' (Logic, 294.)

Protagoras must wait, though waiting in such matters is exceedingly annoying.

Does the Counter-Dilemma really rebut the original Dilemma? The Dilemma appeals to more standards than one, and it is just this fallacy of the change of standard of reference that the Counter-Dilemma exposes. The Counter-Dilemma also appeals to more than one standard, and, so, is itself fallacious. It is no refutation in the proper sense of the word; it suffers from the fault from which the original Dilemma suffers.

Weak points in the Dilemma. Such a complex piece of reasoning as a Dilemma must be liable to many flaws. In fact, some logicians are of the opinion that normally the Dilemma is fallacious. What can be the weak points in a faulty Dilemma?

(1) The major premiss may be false; i.e., the connection said to exist between the antecedent and the consequent may not exist in fact.

(2) The minor may deny the antecedents or affirm the consequents.

(3) The alternatives given in the minor may not be exhaustive.

Of these, No. (2) is the violation of the canon of a Dilemmatic Syllogism. No. (3) is the most common source of hidden fallacy, but this, as well as (1), is a point on which we get light from extraneous sources and not from the structure of the argument itself. Just see how the lazy student argues—

'Easy logical problems need not be attempted now, because, being easy, they can be solved when necessary; difficult logical problems need not be attempted now, because, on account of their difficulty, they cannot be solved.

Now logical problems are either easy or difficult. Therefore, no logical problem need be attempted now.'

He finds it convenient to ignore the fact that quite a large number of problems are difficult so long as you do not grapple with them, but *become* easy when you work upon them. The classes into which his minor divides all the problems are not exhaustive.

CHAPTER XVII

FUNCTION AND VALUE OF THE SYLLOGISM

We have discussed the general nature of the Syllogism, stated rules for testing the validity of syllogistic arguments and considered the various forms of syllogistic reasoning. In this chapter we propose to add a few observations on the function and value of the syllogism. We shall try to answer the following three questions:—

(1) Do we really ever reason syllogistically?

(2) Is the syllogism open to the charge of Petitio Principii?

(3) Are there any Mediate Inferences which are non-syllogistic in character?

1. Do we ever reason Syllogistically? "All inference," says Mill, "is from particulars to particulars; general propositions are merely registers of such inferences already made, and short formulæ for making more. The major premiss of a Syllogism consequently is a formula of this description; and the conclusion is not an inference drawn from the formula; the real logical antecedent or premiss being the particular facts from which the general proposition was collected by Induction." And again, "Certain individuals have a given attribute; an individual or individuals resemble the former in certain other attributes; therefore they resemble them also in the given attribute."

According to Mill, we never reason syllogistically. When we appear to do so, the fact really is that we are reasoning from some particular cases to a new particular case; and this transition in thought is effected on the basis of a certain resemblance between these cases. In Mill's opinion, reasoning by analogy is 'the universal type of the reasoning process.'

Bosanquet goes to the other extreme and maintains that 'in the strict formal sense, there can be no inference from particulars to particulars.' We can pass from one particular case to another only because we perceive a kinship of nature between the two cases. The argument in these cases is really Syllogistic. It may be expressed thus:—

Whatever is true of A is true of B;
It is true of A that it possesses a character C;
Therefore, B possesses the character C.

If the particulars under consideration are mere particulars, without any kinship of nature, explicitly recognised or tacitly assumed, we are quite helpless and can draw no inference.

Both these views are untenable. The Syllogism is *a* mode of reasoning, but not the *only* mode of reasoning.

This controversy, strictly speaking, is beyond the province of Logic. The matter in dispute is a question of fact—whether or not the human mind functions in a particular manner. This is a problem for Psychology and not for Logic. For Logic, the question is whether the Syllogism, if and when we employ it, is a valid form of reasoning.

2. Does the Syllogism involve a Petitio Principii? Some Logicians maintain that the Syllogism involves Petitio Principii. To understand the exact point of the objection, we may take a Syllogism in the first figure:—

> All Barristers in Cawnpore are lawyers of ten years' standing;
> Ram Prasad is a Barrister in Cawnpore;
> Therefore, Ram Prasad is a lawyer of ten years' standing.

The critics of syllogistic reasoning point out that the major premiss in this argument must be the result of an examination of the cases of all Cawnpore Barristers *including Ram Prasad*. This bring so, where is the point in making an assertion about Ram Prasad separately and giving it the dignified name of a conclusion? If we did not examine the case of Ram Prasad, we were not justified in making the universal statement in the major premiss. If we did examine that case, we are not passing to anything new in the so-called conclusion. According to this criticism, the conclusion in the Syllogism is either *invalid* or *unnecessary*.

This criticism assumes that the major is the result of an examination of *all the members of a class*. This is sometimes the case. In these circumstances, the universal proposition is known as an Enumerative Universal. Where the major is such a Universal, the argument cannot escape the charge of a Petitio Principii or Begging the Question.

But all the Universal Propositions are not Universals of this type.

Take the two following Syllogisms:—

(1) All candidates obtaining sixty per cent or more marks at the Intermediate Examination are placed in the First Division.
Ram Nath has obtained sixty per cent marks.
Therefore, Ram Nath will be placed in the First Division.

(2) All hexagons have their internal angles equal to eight right angles.
The figure before me is a hexagon.
Therefore, the internal angles of this figure are equal to eight right angles.

Is the major in the first Syllogism obtained by examining the cases of all candidates of a particular type? Strictly speaking, this major is not *obtained* at all, as a result of examination. It states a regulation framed by an Intermediate Board or a University, and the regulation has really the status of a convention. The limit for the First Division may have been fixed in the past or may be fixed in the future at sixty-five or fifty-five per cent. *So long as this regulation exists*, a candidate who obtains sixty per cent marks is, as a matter of fact, a First Division man. But I may know the regulation and may *not* know that Ram Nath has obtained sixty per cent marks; or I may know about Ram Nath's marks and may *not* know about the regulation. In either case, *I* shall not know that Ram Nath is a First Division man. Neither the major premiss, nor the minor premiss is superfluous. The criticism that we are considering assumes that the minor premiss is superfluous. For omniscience, it may be superfluous; but for a finite intelligence, it is not so.

How is the major in the second Syllogism obtained? Certainly not by measuring the internal angles of all the hexagons. The mathematician does not care to measure the internal angles of a single hexagon to obtain this result. He obtains it by employing rigid mathematical reasoning. The major does not mean that all hexagons have, as a matter of fact, been found to show this property. It means rather that the nature of a hexagon is such that its internal angles cannot but be equal to eight right angles. It is the statement of a Universal relation. Such a proposition is a true Universal, and the charge of Petitio Principii cannot be brought against the Syllogisms that have such propositions as their major premisses. All sciences attempt to obtain true universals, and when such universals have been obtained, they are a source of genuine additional knowledge. When a man declares that 'All men are mortal,' he implies that there is something in the very constitution of man which indicates that death will overtake him sometime. If the proposition were an Enumerative Universal, one could make the statement only on the doomsday, and then too after his own resurrection.

We have said above that when an Enumerative Universal is the major premiss in a Syllogism, the Syllogism cannot escape the charge of Petitio Principii. Take the following as an example:—

.. All students in the College are above eighteen years of age.

Rajendra is a student in the College.

Therefore, Rajenda is above eighteen years of age.

If there is no regulation restricting admission to the College on the basis of age, and the major is affirmed, *after examining the age column of the Admission Register of the College,* the conclusion *is* included in the major premiss, and there is really no inference in this combination of propositions.

What is the result of this discussion? The Syllogisms we have examined are all of the standard form—with a universal proposition as their major premiss. The universal propositions, so far as their significance is concerned, are of several types: some are true universals, some may be called conventional universals, while others are enumerative universals. When a Syllogism has an enumerative universal as its major premiss, it is open to the charge of Petitio Principii; otherwise, it is not.

3. ARE THERE NON-SYLLOGISTIC MEDIATE INFERENCES? Is the Syllogism the only form of valid reasoning? Some Logicians answer this question in the affirmative, but a little consideration will show that unless we distort the meaning of the word Syllogism, we have to acknowledge other forms of Mediate Reasoning. The general feature of all these reasonings is that a relation between two terms is established on the basis of relations that both these terms have with a third term. Now the Syllogism is concerned only with one type

of relation between terms—the relation of Subject and Attribute. (Predicative view of the Import of a Proposition.) There are several other relations which can subsist between terms and which are the ground of valid reasoning. Mr. Bradley mentions the following:—

(1) Synthesis of Identity.

Here a term has one and the same point in common with two or more other terms, and it is inferred that these other terms also have the same point in common. If B is brother of both A and C, then A is brother of C.

(2) Synthesis of Degree.

A term stands in a relation of degree with two or more other terms by virtue of one and the same point; then these other terms are also related in degree. A is hotter than B; B is hotter than C; therefore A is hotter than C. The *a fortiori* argument comes under this.

(3) and (4). Syntheses of Time and Space.

One and the same term stands to two or more other terms in a certain relation of time and space. We shall have a relation of time and space between these other terms. A is to the north of B and B west of C; therefore C is south-east of A. A is a day before B, B contemporary with C; therefore C is a day after A.

In a Logic of Relatives we have to recognise these relations as well as the relations of subject and attribute.

CHAPTER XVIII

FALLACIES

1. Are Fallacies Extra-Logical? Logic is concerned with the principles of correct reasoning. The analysis of valid inference is its main business. Inference is made up of propositions, and propositions consist of terms, and so the study of propositions and terms becomes necessary. When we have considered terms, propositions and inferences, our business, according to some logicians, should end. The consideration of fallacies or pseudo-arguments is no part of Logic. Logic tells us about legitimate inferences, and not about what only appears but really is not an inference. There are others who think that it is in treating of fallacies that Logic vindicates its claim to be considered a practical science. Professor Minto goes so far as to say that the main end of Logic is the organisation of reason against confusion and falsehood, rather than the attainment of truth. "It is only by keeping men from going astray and by disabusing them when they think they have reached their destination that Logic helps men on the road to truth. Truth often lies hid in the centre of a maze, and logical rules only help the searcher onwards by giving him warning when he is on the wrong track and must try another. It is the searcher's own impulse that carries him forward: Logic does not

so much beckon him on to the right path as beckon him back from the wrong. In laying down the conditions of correct interpretation of valid argument, of trustworthy evidence, of satisfactory explanation, Logic shows the inquirer how to test and purge his conclusions, not how to reach them."* Even if we do not go all this length, we must admit that it is the existence of fallacies that calls Logic into existence. This being so, an examination of the various forms of fallacy is an important function of Logic. The chapter on fallacies is a chapter of dont's, and, as everyday experience should teach us, in the intellectual no less than in the moral sphere, prohibitions and warnings are as important as positive injunctions.

2. CLASSIFICATION OF FALLACIES. A fallacy is an argument that seems to establish a conclusion without really establishing it. It is counterfeit reasoning. The reasoner himself may be unaware of any flaw in the argument or he may be conscious of the weakness of the argument and employ it with the object of deceiving another. In the first case, the fallacy is known as a Paralogism; in the second, a Sophism. This distinction is of no logical significance. We are to examine the character of the argument itself.

According to Aristotle, the fallacy lies either in the language or outside the language. He divides fallacies into Verbal (in Diction) and non-Verbal (beyond the Diction).

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*Logic, p. 17.

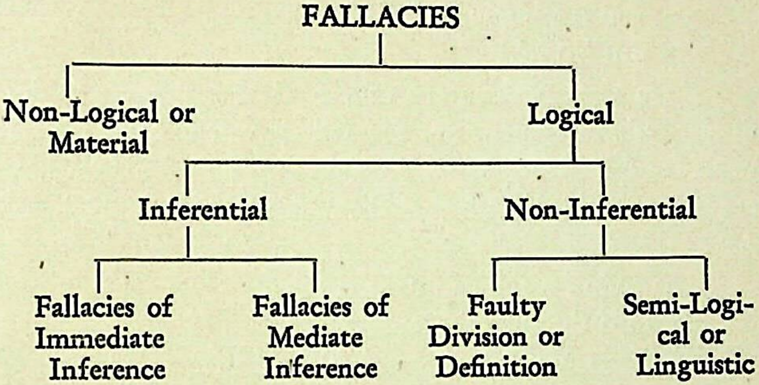
In the non-Verbal Fallacies, the defect may be in the form of thought or in the matter of it. In the former, a conclusion is illegitimately drawn from the premisses; in the latter either one or both the premisses are false, or the conclusion is irrelevant. This gives us the following classification of Fallacies:—

1. Fallacies in Language.
2. Fallacies in Thought
    - (*a*) Formal.
    - (*b*) Material.

Modern logicians do not agree with Aristotle in emphasising language so much as to make it co-ordinate with thought. They proceed on a different basis. They divide fallacies into Logical and Extra-Logical. The Logical fallacies are due to the violation of some logical principles; the Extra-Logical fallacies are due to a defect in the matter of thought. Logical fallacies are further divided into Purely Logical and Semi-Logical; the former arising from a defect in the process of reasoning and the latter being the same as the Linguistic fallacies of the former division. Thus too we get the same three classes, arranged in a new way—

1. Logical
    - (*a*) Purely Logical or Formal.
    - (*b*) Semi-Logical or Linguistic.
2. Extra-Logical or Material.

Some logicians give the following classification of Deductive Fallacies:—


FALLACIES
Non-Logical or Material
Logical
Inferential
Non-Inferential
Fallacies of Immediate Inference
Fallacies of Mediate Inference
Faulty Division or Definition
Semi-Logical or Linguistic

Fallacies of Immediate Inference can be easily detected, and enough has been said in the foregoing pages to enable the reader to see whether a definition or division is faulty. In this chapter, we shall examine in some detail the three remaining classes—(1) Formal Syllogistic Fallacies, (2) Fallacies due to defective language, and (3) Material Fallacies.

3. FORMAL FALLACIES. A formal fallacy arises from the violation of a rule of the syllogism.

The following are the fallacies that are often committed:—

(*a*) Fallacy of Four Terms.
(*b*) Fallacy of Undistributed Middle.
(*c*) Fallacy of Illicit Process.

We shall give examples of each variety.

(*a*) *Fallacy of Four Terms.*

If the four terms are distinct from one another, there is no bond of connection between the extremes, because there is no middle term. Take the following sentences:—

The sun is a luminous body.
My pen is broken.

From these nothing can follow. If a man were to deduce anything from them, the fallacy would be too gross to escape detection. What generally happens in a fallacious argument of this kind is that the middle term is ambiguous. As—

The end of a thing is its perfection;
Death is the end of life;
Therefore, death is the perfection of life.

We shall return to this form of fallacy when we treat of Verbal Fallacies.

Sometimes two terms that partly resemble are taken to be identical. As—

All men who write books are authors;
All educated men could write books;
All educated men are authors.

(*Stock.*)

To write books is not the same thing as to have the capacity for doing it. The following argument is fallacious, though the conclusion may be true:—

A is a friend of B;
B is a friend of C;
∴A is a friend of C.

(*b*) *Fallacy of Undistributed Middle.*

(1) All cows are quadrupeds;
All dogs are quadrupeds;
∴All dogs are cows.

(2) None but the Hindus Worship Brahma;
All Punjabees are Hindus;
∴All Punjabees worship Brahma.

Put the major premiss in the logical form, and then test the argument.

(*c*) *Illicit Process.*

(*i*) of the Major.

(1) All birds are feathered;
Bats are not birds;
∴Bats are not feathered.

(2) All warm countries produce wine;
Russia is not a warm country;
∴Russia does not produce wine.

(*ii*) of the Minor.

(1) All Hindus believe in the Vedas;
All Hindus are Asiatics;
∴All Asiatics believe in the Vedas.

(2) All crows are black;
All crows are bipeds;
∴All bipeds are black.

In complex syllogisms, the violation of the canon of the syllogism will give rise to a fallacy. Thus—

If the rain falls, the streets become muddy;
The rain does not fall;
∴The streets do not become muddy.

4. FALLACIES OF LANGUAGE. 'Fallacies of language', says Minto, 'are mere Verbal Quibbles, and hardly deserve serious treatment, still less minute sub-division.' 'The world

was young when time was spent upon them.' It is difficult to concur in this; even now fallacy so often lurks in the language. Words are not the innocent things that we are apt to suppose.

Aristotle enumerates six kinds of Verbal Fallacies:—

(*a*) Equivocation or Ambiguity of Word.
(*b*) Amphiboly or Ambiguity of Structure.
(*c*) Fallacy of Composition.
(*d*) Fallacy of Division.
(*e*) Fallacy of Accent.
(*f*) Fallacy of Figure of Speech.

(*a*) *Equivocation or Ambiguity of Word*

(1) Bats are birds;
The principal manufacture of Rama & Co. are bats.
∴The principal manufacture of Rama & Co. are birds.

(2) The rat is a common noun;
A prominent cause of the spread of plague is the rat;
∴A prominent cause of the spread of plague is a common noun.

(3) Light dispels darkness;
Feathers are light;
∴Feathers dispel darkness.

(4) All criminal actions should be punished;
Prosecutions for theft are criminal actions;
∴Such prosecutions should be punished.

(*b*) *Amphiboly or Ambiguity of Structure.*

This fallacy is committed when a proposition is capable of being interpreted in more ways than one.

(1) Pyrrhus, the Romans shall, I say, subdue.

(2) The duke yet lives that Henry shall depose.

(3) I went to Amritsar and delivered a speech there on Tuesday.

(4) Twice two and three are ten.
∴Seven is ten.

(5) "How do you do?" "Do what?" "I mean, how do you feel?" "How do I feel? With my fingers, of course; but I can see very well." "No, no; I mean how do you find yourself?" "Then why did you not say so? I never exactly noticed, but I will tell you next time I lose myself." (*Minto.*)

(*c*) *Fallacy of Composition.*

By this Aristotle meant an illicit conjunction of words.

Mohan is a good man;
Mohan is a sportsman;
∴Mohan is a good sportsman.

According to modern logicians, this fallacy is committed when from the distributive use of a term we pass to its collective use.

(1) Hamlet, Othello, Macbeth and Lear can be read in three hours.

∴The tragedies of Shakespeare can be read in three hours.

(2) All the bricks are perfect cubes;
∴The collection of bricks is a perfect cube.

(3) No man in the village can contribute fifty rupees;
∴The villagers cannot contribute fifty rupees.

'This is a fallacy,' says Whately, 'with which men are extremely apt to deceive *themselves*, for when a multitude of particulars are presented to the mind, many are too weak or too indolent to take a comprehensive view of them; but confine their attention to each single point, by turns; and then decide, infer, and act accordingly; e.g., the imprudent spendthrift, finding that he is able to afford this *or* that, *or* the other expense, forgets that *all of them together* will ruin him.' How many students find towards the close of a month that they have committed the fallacy of composition?

(*d*) *Fallacy of Division.*

According to Aristotle, this fallacy is an illicit disjunction of words.

Ram Nath is a good sportsman;
Therefore, Ram Nath is a sportsman and a good man.

According to modern logicians, this fallacy is committed when from the collective use of a term we pass to its distributive use.

(1) The trees in the garden form a thick shade;
This is a tree in the garden;
∴This tree forms a thick shade.

(2) The angles of a triangle are equal to two right angles;
<A is the angle of a triangle;

$\therefore \angle A$ is equal to two right angles.

(3) Indians are of a speculative turn of mind;
A, B, and C are Indians;
∴A, B, and C are of a speculative turn of mind.

Just as the spendthrift commits the fallacy of Composition, the miser commits the fallacy of Division. He finds that he cannot purchase books, *and* go to the hills, *and* contribute to charitable institutions; and infers that he cannot do any one of these things.

(*e*) *Fallacy of Accent.*

This fallacy is committed when by emphasising a wrong word we distort the meaning of a sentence. If in quoting a passage we italicise words not italicised in the original, we may be changing the meaning of the passage.

'Thou shalt not bear false witness against thy neighbour.'

If the preacher emphasises the word *against*, the audience is justified in concluding that false witness may be borne *in favour of* your neighbour. If the words *thy neighbour* are emphasised, the inference would be that false witness may be borne against those who live far off from you.

'You should not run to the college just now.'

The meaning of the sentence will vary according as we emphasise *you*, *run*, *college*, or *just now*.

(*f*) *Fallacy of Figure of Speech.*

This fallacy arises from a confusion of grammatical forms. Words derived from the same source but having different meanings are used as if they had the same meaning.

(1) Projectors are not to be trusted;
This man has formed a project;
∴ This man is not to be trusted.

(2) Rama is a brilliant student in the Arts School;
∴ He is very artful.

(3) All visionaries are unpractical;
Gobind is a pronounced visualiser;
∴ Govind is unpractical.

(4) All creditors are unhappy;
Lakshman is a man of credit;
∴ Lakshman is unhappy.

(5) Mill's proof of pleasure being a good is as follows: 'The only proof capable of being given that an object is visible, is that people actually see it. The only proof that a sound is audible, is that people hear it; and so of the other sources of our experience. In like manner, I apprehend the sole evidence it is possible to produce that anything is desirable, is that people do actually desire it.' Mill does not notice that whereas *visible* and *audible* mean what *can* be seen and heard, *desirable* means not what *can* be, but what *ought to be* desired.

5. MATERIAL FALLACIES.. Under this head fall the following seven classes:—

(*a*) Fallacy of Accident.
(*b*) Converse Fallacy of Accident.
(*c*) Fallacy of the Consequent or Non-sequitor.
(*d*) Fallacy of False Cause or Non-causa Pro-causa.
(*e*) Fallacy of Irrelevant Conclusion or Ignoratio Elenchi.

(*f*) Fallacy of Begging the Question or Petitio Principii.

(*g*) Fallacy of Complex Question.

We shall briefly characterise and illustrate them.

(*a*) *Fallacy of Accident.*

This fallacy is committed when we suppose that what holds true under general conditions also holds true under particular circumstances. The fact may be that the particular circumstances entirely alter the case.

(1) A man refuses to take alcohol when ordered by a doctor on the ground that alcohol is a poison and must not be taken. His inference is fallacious, because the circumstance that he is ill and alcohol is prescribed by a man who is expected to understand the laws of health, entirely alters the case.

(2) 'Milk is a nutritious food and therefore contaminated milk also is useful.' Here it is forgotten that the contamination of milk may make it positively injurious.

(3) Exercise is necessary for health; therefore, a man suffering from typhoid fever should take exercise.

According to ancient logicians this fallacy is committed when we confound essential attributes with accidental attributes. As—'Is Plato different from Socrates?' 'Yes.' 'Is Socrates a man?' 'Yes.' 'Then Plato is different from man'.

Plato is different from Socrates not in the essential attributes that make the latter a man, but in some accidental or inessential points.

(*b*) *Converse Fallacy of Accident.*

This Fallacy is committed when we argue from a special case to a general rule, or when we suppose that what holds true under special circumstances holds true generally.

(1) A man who was allowed the use of alcohol while he was ill, continues to use it after he has recovered.

(2) A man is asked not to take exercise when he is suffering from some organic trouble, and infers that to take exercise is always bad.

(3) The surgeon who is allowed to perform an operation upon a diseased limb infers that he can use his knife on the body of any man, diseased or healthy.

(4) A soldier who receives some praise for the use of his sword on the field of battle thinks that he need not respect others' right to live.

(*c*) *Fallacy of the Consequent or Non-sequitor.*

This fallacy is committed when the conclusion that is drawn does not in fact follow from the premiss or premisses.

(1) If the rain falls, the streets are muddy;
Therefore, if the streets are muddy, the rain has fallen.

(2) If A is true, I is true;
Therefore, if I is true, A is true.

(*d*) *False Cause or Non-causa Pro-causa.*

This is an Inductive Fallacy. Here what is not a cause is mistaken for a cause.

A mere antecedent of a phenomenon is supposed to be the cause of the phenomenon. A man sneezes and presently the earthquake shakes the town. He supposes that his sneezing is the cause of the earthquake. The appearance of comets in the sky is supposed to be the cause of national disasters. The sight of a Brahmin or a cat is regarded as ominous when we leave our home for some serious business. Incantations and arsenic will kill a flock of sheep. The fallacy of False Cause is committed when arsenic is left out of account and death is ascribed to incantations. Almost all the superstitious beliefs are cases of this fallacy.

(*e*) *Ignoratio Elenchi.*

This literally means 'ignorance of confutation.' When I am engaged in controversy with another, my business is to prove the contradictory of his assertion. Only thus do I demolish his position. If I establish a conclusion different from this, I show that I am ignorant of or ignore the nature of confutation. This fallacy has several forms—

(1) *Argumentum ad hominem.*—When we want to demolish another's position, we proceed to attack his character or show that he himself once thought differently from what he now thinks. We cannot show that a proposal is bad by condemning the man from whom it proceeds.

(2) *Argumentum ad populum.*—Here we appeal to popular passion or prejudice. A man declaiming against the free movement of women asks the audience to raise hands if they want that the ladies in their homes should promiscuously mingle with men of all sorts and exhibit themselves in public streets. This fallacy is generally committed in political controversies.

(3) *Argumentum ad verecundiam.*—It is an appeal to

a man's reverence for authority. In a controversy, many are silenced as soon as a quotation (real or supposed) from a great author is cited against them.

A young man with his brain full of new ideas is told to be modest; his forefathers were not fools.

(4) *Argumentum ad baculum.*—This is an appeal to force. As Stock remarks, 'to knock a man down when he differs from you in opinion may prove your strength, but hardly your Logic.' Religious persecutions may be regarded as a practical form of this fallacy. 'The reformer who is executed, or the martyr who is burnt at the stake, is not by this act necessarily proved in error; it is only shown that his opponents were stronger than he, which is a very different point indeed. To make an end of the man by violence or bullying, does not refute, by reason, or even make an end eventually of his conclusion.' (*Veitch.*)

(5) *Argumentum ad ignorantiam.*—This is an appeal to the ignorance of the hearer or the reader. We suppose that he will accept our position because he has no capacity of seeing through the fallacy.

(6) *The fallacy of objections.*

We show that there are some objections against a plan, scheme or theory, and jump to the conclusion that it must be rejected. The point that should be proved is that there are more or stronger objections against adopting it than against rejecting it. This fallacy, says Whately, is 'the stronghold of bigoted anti-innovators, who oppose all reforms and alterations indiscriminately, for there never was or will be, any plan executed or proposed, against which strong or even unanswerable objections may not be urged; so that unless the opposite objections be set in the balance on the other side, we can never advance a step.'

Even in such simple things as the arrangement of seats in the class room or the boarding house, it is well nigh impossible to make your principle of arrangement unassailable. However, this does not mean that you are not to proceed to your business.

(*f*) *Petitio Principii.*

This fallacy is committed when a proposition is proved by means of another and this other is proved by means of the original proposition. Practically a proposition is proved by itself. If this is done in a couple of syllogisms, the fallacy is quite obvious; thus—

A is B.	C is B.
C is A.	A is C.
∴ C is B.	∴ A is B.

When we have a fairly long series of connected syllogisms, the fallacy is apt to remain undetected. The reasoning comes back whence it starts, and for this reason, the fallacy is called *arguing in a circle*. In the wider sense, it is called the fallacy of *Begging the Question*.

Sometimes the argument may be vitiated by the use of what are called *question-begging epithets*. Call a dog mad and kill it. Call a new measure a reform and those that accept this name are already for it. Call it an innovation and those that accept the name are likely to condemn it.

The fallacy of Petitio Principii has the following forms—

(1) The conclusion simply repeats the premiss in different words. As, opium brings about sleep because it has soporific properties. Heat expands bodies because the particles of a body when it is heated are driven off from each other. This man is a coward because he lacks manliness. The fallacy in this form is called *hysteron proteron.*

(2) A general principle which involves the required conclusion is taken for granted, when, as a matter of fact, this principle itself stands in need of being proved. To prove that the monkey in my cage is mischievous, I may assume that all monkeys are mischievous.

All universal propositions are not provable, and, therefore, it is not necessary that whenever we pass from a universal to a particular, we commit this fallacy. The fallacy is committed only if a universal proposition is assumed to be axiomatic, when it is not so.

Some critics maintain that the Syllogism commits a petitio principii.

(3) Particulars involved in the universal to be proved are assumed. When all the particulars that fall under the universal are assumed, really there is no inference of the universal. If to show that the class is excitable, I assume that each student is excitable, I am assuming the very thing to be proved.

(4) Another form rests on immediate inference by converse relation. A is the father of B, because B is the son

of A. Lahore is to the west of Amritsar, because Amritsar is to the east of Lahore.

(g) *Fallacy of complex question.*

This fallacy is committed when a question is asked which appears to be simple but in reality is a question plus some illegitimate assumptions. A classical instance of this form of the fallacy is—Have you left off beating your mother? The answers 'Yes' and 'No' both would imply an admission of the practice. No questioner can demand an answer to such a question in the form of 'Yes' or 'No'. The question is not a simple one. It is equivalent to an assertion that the beating was practised and an enquiry whether the practice still continues. Other questions of the same type are—'When will you return the money that you borrowed from me?' 'Why have you sent Gopal Krishna away?'

HOW TO TEST AN ARGUMENT? How can we find whether an argument is valid or fallacious? The first thing that is necessary is to throw the argument in a regular form. Turn to the conclusion and determine the middle, major and minor terms. Then see whether the middle is distributed and the terms distributed in the conclusion are distributed in the premisses. Be sure, that is, that the rules of the Syllogism relating to quantity are not violated. Then think of the other rules. The fallacy, if it is Logical, will be thus detected. Critically examine the language of the argument. Among verbal fallacies, those of Composition and Division are the most frequently committed. Among extra-logical fallacies, Ignoratio Elenchi and Petitio Principii deserve special attention. But when all this is said, it must be confessed that the detection of a fallacy is largely a question of 'eyes and no eyes.' A sharpwitted man will at once see through a fallacy, where another with a long list of rules will be helpless. All that we can say is—try. Here, as elsewhere, practice improves. Many fallacies will be found to be much more subtle than those that we have chosen as examples: Do not ignore minute points, for, as Whately so well puts it, 'it is for want of attention to minute points, that houses are robbed or set on fire. Burglars do not in general come and batter down the front door: but climb in at some window whose fastenings have been neglected. And an incendiary, or a careless servant, does not kindle a tar-barrel in the middle of a room, but leaves a lighted turf, or a candle snuff, in the thatch or in a heap of shavings.'

APPENDIX

QUESTIONS AND PROBLEMS

CHAPTERS I AND II

1. Define Logic and explain your definition. Is Logic a Science or an Art? (1907.)

State briefly the nature of Logic in the light of the following remark:—"A science teaches us to know and an art to do." (1911.)

2. Is Logic concerned with Language, Thought or Objects?

What is the place of Logic among the Sciences? How is it related to Psychology and Grammar? (1916.)

3. Distinguish between the Form and Matter of Thought. With which of them is Logic concerned?

4. Examine the following statements as to the province and function of Logic:—

(*a*) The Science not of truth, but of consistency. (1916.)

(*b*) The Science of the operations of the Understanding which are subservient to the estimation of evidence.

(*c*) A machine for combating Fallacy. (Welton and Monahan.)

5. Discuss the significance of the Laws of Identity, Contradiction and Excluded Middle. (1917.)

Are these laws independent of each other?

6. Does Logic expound the laws that actually govern, or the laws that ought to govern, the reasoning process? What are the main sub-divisions of Logic? (*Madras.*)

7. What is Logic good for? (1914.)

When Locke said, in criticism of the Scholastic Logic, that 'God has not been so sparing to men to make them barely two-legged creatures, and left it to Aristotle to make them rational," what misconception was he under as to the function and value of Logic? (M.) Is it true to say that Logic teaches us to reason? (1915.)

8. Logic is spoken of as a Regulative Science. What are the characteristics of a Regulative Science? How does Logic, a Regulative Science, differ from Æsthetics and Ethics? (M.)

9. Explain the following remark:—

> "Formal Logic is concerned with consistency and not with Truth."

Can false premisses furnish a true conclusion? (1918.)

Chapters III and IV

1. Distinguish the following terms:—

Abstract and Concrete; Singular, General and Collective; Connotative and Non-Connotative. Give examples. (1905, 1906, 1912.)

2. Distinguish the collective and distributive use of a term, and show by a concrete example how fallacies arise from confusion of these two uses. (1907.)

3. Give the logical characters of the following terms:—

(*a*) Socrates, man, human, humanity, mankind. (1905.)

(*b*) Virtue, planet, square, equal, beauty. (1906.)

(*c*) Faith, convenience, the brightness of this light, deaf. (M.)

(*d*) College, the garden, brotherhood, fault, faulty.

4. Does the distinction of singular and general apply to abstract terms?

5. What is meant by the Universe of Discourse? Do a positive and a negative term exhaust the Universe absolutely or only the Universe of Discourse?

6. Distinguish Contrary and Contradictory Opposition between Terms. What is Repugnance?

7. Explain and illustrate the relation between the extension and intension of a term. (1907, 1910, 1913, 1920. Al. 1920.) Can the two kinds of meaning be said to vary inversely?

8. Have all terms a two-fold meaning?

'Logicians have erroneously asserted that singular names are devoid of meaning in intension, the fact being that they exceed all other terms in that kind of meaning.' (Jevons.) Explain and discuss this.

9. Explain:—

'Analysis in Extension is Synthesis in Intension.' (1908.)

10. Examine the view that the connotation and the denotation of a term vary inversely. Are there any terms whose denotation may increase without any change in con-

notation, and terms whose connotation may increase without any change in the denotation? (1917.)

11. Arrange the following terms in series, putting in each series a term of greater extension before a term of smaller extension:—Metal, steamship, matter, horse, book, element, animal, dictionary, being, iron, ship, printed book, man, organised matter, Philip, substance, screw-steamship, king, illustrated dictionary. (Jevons.)

12. Distinguish between a Significant Singular Name and a Proper Name. Discuss the question of the connotation of Proper names. (1918.)

CHAPTERS V, VI AND VII

1. Define Predicables (and show how they bring out the distinction between Verbal and Real propositions). (1907.)

Give Porphyry's scheme and explain the meaning of the words by reference to some common object. (1915.)

2. Explain, giving illustrations:—

Difference, fundamentum divisionis, property. (1910).

3. Point out the relations of Genus, Species, Difference, Property and Accident respectively to the connotation of the subject of which they are predicates.

4. Enumerate and define the Predicables.

Comment upon the following:—

"Genus is a part of Species and Species is a part of Genus." (1918; Al., 1920.)

5. Show the connection of the Predicables with the doctrine of Division and Definition. (M.)

6. Distinguish between Definition and Description. Give a definition and a description of some common object. (1915.)

7. Explain Logical Division, stating and illustrating the rules by which it is governed. What is the relation between Division and Definition? (1907 and 1915.)

8. Criticise the following definitions and revise them:—

(*a*) (*i*) Music is an expensive noise.
(*ii*) Fame is fancy's life in others' breath.
(*iii*) Necessity is the mother of invention. (1911.)

(*b*) (*i*) Money is metal in the shape of circular disks.
(*ii*) Joy is the absence of sorrow.
(*iii*) A city is a more or less thickly populated place having a post office and a tank. (1914.)

(*c*) (*i*) A poet is an apostle of sweetness and light.
(*ii*) A gentleman is a man who has no visible means of support. (1917.)

9. Define "man" and illustrate from your definition rules for testing any definition. Show also by constructing examples how these rules may be violated. (1905, 1913.)

10. Explain the defects, or justify the correctness, according to the rules of Logic, of the following:—

(*a*) Definition of 'countries' as 'sub-divisions of continent.'

(*b*) Division of 'Nation' into 'European, Asiatic and uncivilized nation.' (1910.)

11. Distinguish between (*a*) a logical whole, (*b*) a metaphysical whole, (*c*) a physical whole, (*i*) mechanical and (*ii*) chemical. Describe the process by which each kind of whole is resolved into its parts. (M.)

12. "Europeans are divided into Ketls, Teutons, Slavs, Frenchmen, Spaniards, the Emperor of Russia and the President of the United States." What rules of Logical Division are violated here? (M.)

CHAPTERS VIII AND IX

1. Give outlines of the Division of Propositions. Give examples of Real and Verbal propositions. Define and distinguish between them. (1913.)

2. Define Categorical, Hypothetical, and Disjunctive Propositions.

Give an example of each of these forms, and convert into the remaining two forms. (1918.)

3. Express the following propositions in Logical form, affixing the proper symbol and naming the term or terms that are distributed:—

(*a*) (*i*) Every bullet does not kill.

(*ii*) He envies others' virtue who has none himself.

(*iii*) All the apostles are twelve. (1905.)

(*b*) (*i*) Not all who are called are chosen.

(*ii*) Only doctors understand this subject.

(*iii*) A fool is not always wrong. (1906.)

(*c*) (*i*) All the witnesses are not trustworthy.

(*ii*) If it rains, the ground will be wet.

(*iii*) Only skilful surgeons can perform the operation. (1907.)

4. Determine the quality and quantity of the following propositions:—

(*i*) The virtuous alone are happy.

(*ii*) He can't be wrong whose life is in the right.

(*iii*) None but the brave deserve the fair.

(*iv*) No one can be rich and happy unless he is also temperate and prudent, and not always then. (Resolve into two propositions.)

(*v*) No child ever fails to be troublesome, if ill-taught and spoilt.

(*vi*) It would be equally false to assert that the rich alone are happy or that they alone are not. (Venn.)

(Resolve this into two *false* propositions, and then obtain the two *true* propositions implied by them.)

5. How would you interpret the Copula in a proposition? Explain Hamilton's doctrine of Quantification of the Predicate. On what assumption is it based? What are its chief advantages? (1920.)

6. Enumerate the various theories of Predication. Can

you assign a characteristic name to each of them? (1914, 1917.)

7. Distinguish between the logical 'some' and 'some' of common speech. What is the significance of *most, few, a few*?

8. What are the requisites of a good scheme of Diagrams? Give Euler's scheme and estimate its value.

CHAPTERS X AND XI

1. Explain the meaning of the following logical terms, giving illustrations:—Contrary Propositions, Contradictory Propositions. (1910.)

2. Give the logical opposites of the following propositions:—

(*i*) Happy is the man that findeth wisdom.
(*ii*) The square of three is nine. (1905.)

3. State the propositions contradictory and subaltern to the following, illustrating each proposition by a diagram:—
"No men are perfect." (1908.)

4. What will you infer from the falsity of A, E, I and O? Why is it desirable in a controversy to refute a false statement by its contradictory and not by its contrary? (1911.)

5. Show by the use of diagrams that

(*i*) the sub-contraries can both be true and cannot both be false;
(*ii*) the contraries can both be false, but cannot both be true;

(*iii*) the contradictories cannot both be true, nor can both be false.

6. Represent the ordinary forms of the Categorical Proposition by Euler's Diagrams, and determine, by reference to these Diagrams, or otherwise, the relations between (*i*) A and E, (*ii*) I and O. (1918.)

7. Give the converse, obverse, and inverse of the following:—

(*i*) No display of passion is politic.
(*ii*) Energy commands success. (1905.)

8. Define converse by negation and inverse, and give the converse by negation and inverse of the following:—

(*i*) Mortals cannot be happy.
(*ii*) Envious men are disliked. (1906.)

(Converse by negation is converse of obverse. We have called this contrapositive. Some Logicians, e.g., Stock, use the name contrapositive for the obverse of the converse of obverse.)

9. Show that Eductive Inferences are based on the Laws of Thought.

10. (*a*) What are the simplest propositions that must be established in order to disprove the following:—

(*i*) All is not lost.
(*ii*) Some knowledge is not of any value.
(*iii*) The virtuous alone are happy.
(*iv*) Many are called, but few chosen.

(*b*) Supposing that no good man is unhappy, what can you predicate about (*i*) Unhappy men, (*ii*) Happy men, (*iii*) Bad men? (M.)

11. Give the logical converse of the following:—

(*a*) All women are not vain.

(*b*) Energy commands success.

Granting the truth of the first proposition, what other propositions can be inferred by opposition to be true or false? (1911.)

12. (*a*) Give the converse, obverse and contrapositive of the Exceptive proposition: All but graduates are eligible. Also express the given judgment in the form of an Exclusive proposition. (1911.)

(*b*) Mention all the immediate inferences which may be drawn from the proposition, "The virtuous alone are wise." (1917.)

13. What further proposition can you form (by the processes of conversion and obversion alone) from the following propositions:—

(*a*) All Indians are religious.

(*b*) Some mathematicians are philosophers.

(*c*) "No rose without a thorn." (1910).

14. What counter-implications may be involved in the following proposition:—

"Cholera is now prevalent in the Punjab." (1914.)

15. Select out of the following propositions, the pairs of contrary, contradictory and subaltern propositions:—

Some elements are known.

No elements are known.

All elements are known.
Not all elements are known.
Some elements are not known.
All elements are not known. (Jevons.)

16. Give the contradictories of:—

(*i*) None but the truthful are virtuous.
(*ii*) Some but not all men are truthful.
(*iii*) If one is truthful, then one is virtuous. (M.)

17. Examine in case of each of the following propositions, the precise meaning of the assertion that the proposition is false:

(*i*) Some electricity is generated by friction.
(*ii*) Oxygen and Hydrogen are constituents of the air we breathe.
(*iii*) If a straight line falling upon two other straight lines makes the alternate angles equal to each other, these two straight lines shall be parallel.
(*iv*) Actions are either good, bad or indifferent.

18. Classify the propositions subjoined into the four following groups:—

(*a*) Those which can be inferred from (1).
(*b*) Those from which (1) can be inferred.
(*c*) Those which do not contradict (1), but cannot be inferred from it.
(*d*) Those which contradict (1).

(1) All just acts are expedient acts.
(2) No expedient acts are unjust.
(3) No just acts are expedient.

(4) All inexpedient acts are unjust.
(5) Some unjust acts are inexpedient.
(6) No expedient acts are just.
(7) Some inexpedient acts are unjust.
(8) All expedient acts are just.
(9) No inexpedient acts are just.
(10) All unjust acts are inexpedient.
(11) Some inexpedient acts are just.
(12) Some expedient acts are just.
(13) Some just acts are expedient.
(14) Some unjust acts are expedient. (Jevons.)

19. Enumerate and define the various forms of immediate Inference.

From All S is P, can you infer—
Some non-P is not non-S? (1918.)

CHAPTERS XII, XIII AND XIV

1. Define a Syllogism and distinguish it from other forms of Mediate Inference. (1906.)

2. Prove the following syllogistic rule:—

The Middle Term must be distributed at least once in the premises. (1906.)

Give an example of the fallacy committed by neglect of this rule (1908.)

3. Construct Syllogisms in the following moods and figures, stating whether they are valid or invalid and giving your reasons in each case.

A E O (I), E A O (II), I A I (III), I A I (IV). (1905.)

4. (*a*) Define figure and distinguish the different figures.

(*b*) Test the following moods in each figure and find out in which each of them is valid: EAE, AII. (1906.)

5. Define Mood and Figure. Write out the 64 possible moods of the Syllogism and strike out 53 invalid moods. (1907.)

6. State the special rules of the first figure and prove that I E premisses give no conclusion.

7. What are the peculiar characteristics of each of the four Figures, and what is the special use of each? (1920.)

8. Name the rules of the syllogism broken by the following moods:—E E I, A I A, I E A, I O I, I I A, A E I. (1911.)

9. The third figure is used in proving exceptions. Illustrate. (1913.)

10. Prove that O cannot be a major premiss in the second and a minor in the other figures.

Show by general reasoning that E A O is valid in all figures. (1913.)

11. Is a mood with universal premisses and a particular conclusion always a subaltern mood? Give instances to illustrate your answer.

12. Show that when the Middle Term is distributed twice, the conclusion is particular. (Al. 1920.)

13. In what figures are the following moods valid?—

I A I, A O O, E A A, I E O.

14. What moods are good in the first figure and faulty in the second, and *vice versa*?

15. The fourth figure is sometimes spoken of as unnatural and unnecessary. Discuss this.

16. Define the following terms:—
Minor Premiss, Undistributed Middle, Illicit Process of the Major, Weakened Mood, Strengthened Mood. Illustrate.

17. Represent *Darii, Camestres, Bokardo, Fesapo,* by means of Euler's circles. (M.)

Construct a syllogism in Bokardo and one in Ferison proving the conclusion that "all is not gold that glitters." (1917.)

18. Given the truth of one premiss and the conclusion, can we establish the truth of the other premiss? (M.)

If the conclusion of a syllogism be substituted for the major premiss and the resulting premisses yield a legitimate conclusion, determine the figure and mood of the new syllogism. (1917.)

19. State the Dictum. Can you derive the rules of syllogism from it? What objection can be taken to the ordinary statement of the Dictum?

20. Prove that in every figure, if the minor premiss is negative, the major premiss must be universal (Al. 1920.)

21. Supposing that S, M and P are the minor middle and major terms respectively of two valid syllogisms in the same figure, show that if the minors are contradictories, the conclusion cannot be contadictories. (M.)

22. Construct all the possible syllogisms in which 'some S is not P' is a valid conclusion. (M.)

23. Prove that if a valid syllogism contains O as a premiss, its middle term must occupy the same position in both premisses. (M.)

24. Determine the Figure and Mood of the Syllogisms in which the conclusion is (*i*) Universal Negative (*ii*) Universal Affirmative. (1918.)

25. What is reduction? Distinguish between the two kinds of Reduction.

26. What is the use of Reduction? Give examples. (1913, 1916.)

Is Reduction an essential process in the doctrine of Syllogism?

27. Reduce Baroco (1905, 1918), Darapati and Bramantip (1906, 1918); A O O and A E E of the second figure (1912). Reduce Ferio into Figure II and Celarent to Barbara. (1912.)

28. Camestres, Bokardo. What do you call these expressions? What do the various letters signify? Using these typical illustrations, explain the process of Reduction. (1914.)

29. Reduce Fesapo and Camestres ostensively and by *reductio ad impossible*. If K stands for obversion, show that the moods Baroko and Bokardo may be replaced by Faksoko and Doksamosk. (M.)

CHAPTERS XV AND XVI

1. Classify syllogisms and give an example of each class.

2. Define Enthymeme and Epicheirema. Name and illustrate the varieties of each.

3. What is a Sorites? Give examples of the two kinds of Sorites. Are there really two different types of the Sorites?

4. Give an example of a Regular Sorites, and analyse it into its constituent Syllogisms. (1918.)

5. Show that in the Sorites one premiss can be negative. and that must be the last in the Progressive and the first in the Regressive form. Are the names Progressive and Regressive appropriate?

6. What is meant by Prosyllogism and Episyllogism? Illustrate.

7. Give an account of the various kinds of Complex Syllogisms, with original examples. (1920.)

8. It has been maintained that the Hypothetical Syllogism is an Immediate Inference. Discuss this.

9. Show that the canon of the Disjunctive Syllogism depends upon the interpretation that we put upon the Disjunctive Proposition.

10. Name and illustrate the various kinds of the Dilemma.

11. Is the rebuttal of a Dilemma a contradiction of it? What can we say about the validity of the rebutting Dilemma? What are the weak points in a Dilemma?

12. Express the following arguments in the form of Dilemma:—

(*i*) A man who is devoid of either gentleness or spirit cannot possibly make a good guardian. As these qualities seem to be incompatible, the result is that a good guardian is an impossibility.

(*ii*) Easy exercises can be done when required; difficult exercises cannot be done even with effort; therefore, trying exercises at home is of no use.

(*iii*) A married man is uneasy on account of heavy responsibilities; a bachelor is uneasy on account of want of loving companions; therefore, human life is miserable.

Rebut the last Dilemma.

CHAPTER XVIII

1. Classify Fallacies. What is the outstanding feature of Aristotle's classification? Is it a defect?

2. Illustrate the following fallacies:—

Amphiboly, Composition, Division, Accident, Non-sequitor, Figure of Speech, Complex Question, Ignoratio Elenchi, Petitio Principii.

3. Test the following arguments:—

(*a*) All plants are organised; no crystals are plants; therefore, no crystals are organised.

(*b*) A material body is either solid or fluid; this body is solid; therefore, it is not fluid.

(*c*) Every rule has exceptions; this is a rule and has exceptions; therefore, some rules have no exceptions.

(*d*) Every hen comes from an egg; every egg comes from a hen; therefore, every egg comes from an egg.

(*e*) All metals are elements; therefore, the rarest of the metals is the rarest of the elements.

4. Examine the following arguments:—

(*a*) Wicked men are not to be trusted.
Gopal is not to be trusted; therefore, he is a wicked man.

(*b*) To call you a man is to tell the truth; to call you a saint is to call you a man; therefore, to call you a saint is to tell the truth.

(*c*) Rama is wiser than Krishna; Krishna is wiser than Narain; therefore, Rama is wiser than Narain.

(*d*) Buddhists alone are over-sensitive; this man is a Buddhist, therefore, this man is oversensitive.

(*e*) You are not what I am; I am a man; therefore, you are not a man.

5. Examine the following arguments:—

(*a*) (*i*) Only contented people are wise.
Therefore, the tramp contented in his rags is necessarily a wise man.

(*ii*) No tale-bearer is to be trutsed, and, therefore, no great talker is to be trusted, for all tale-bearers are great talkers.

(*iii*) If he robs, he is not an honourable man; if he pays all his dues, he does not rob; therefore, if he pays all his dues, he is honourable. (1905.)

(*b*) (*i*) Teetotallers do not use alcoholic drinks and this man does not do so; therefore he is a teetotaller.

(*ii*) All the men are quite sufficient for the job; you are one of them; therefore, you are quite sufficient for it.

(*iii*) All good shepherds are prepared to lay down their lives for the sheep; few in this age are so prepared; therefore, few in this age are good shepherds. (1906.)

(*c*) (*i*) What the law permits is morally right; indulgence in pleasure is permitted by law; therefore, indulgence is morally right.

(*ii*) Is a stone a body? Yes. Then is not an animal a body? Yes. Are you an animal? I think so. Ergo, you are a stone, being a body. (1911.)

(*d*) (*i*) France and United States are republics; they have both shown strong tendencies to corruption; therefore, the republics are liable to corruption.

(*ii*) The crime was committed by the criminal;

the criminal was committed by the Magistrate; therefore the crime was committed by the Magistrate. (1911.)

(*e*) (*i*) This lamp saves half the ordinary amount of oil; therefore, two such lamps would save it all.

(*ii*) There must be widespread discontent, for the head of the department has received an anonymous letter threatening him (1913.)

(*f*) (*i*) You ought not to convict the prisoner because his grandfather was a famous Judge.

(*ii*) Your father would die of shame, if he knew you held such beliefs. (1914.)

(*g*) (*i*) An honest man is the noblest work of God. Ram Lal is an honest man. Therefore, he is the noblest work of God.

(*ii*) He must be conceited because he wears high collars.

(*iii*) Nothing which is cruel can be expedient, for cruelty is most revolting to the nature of man. (1915.)

6. Examine the following arguments:—

(*a*) (*i*) If you grant that all patriots are unselfish, why, it follows naturally that non-patriots are selfish.

(*ii*) All useful things are beautiful, since nothing is beautiful except what is useful. (M.)

(*b*) (*i*) Aristotle is a word of four syllables.
Aristotle is acute.
Acute is a word of four syllables.

(*ii*) To live well is better than to live; hence not to live is better than to live badly.

(*iii*) If I am to pass this examination, I shall pass it whether I answer correctly or not; if I am not to pass it, I shall fail whether I answer correctly or not; therefore it is of no consequence how I answer the question paper. (1917.)

(*c*) (*i*) He who is most hungry eats most; he who eats least is most hungry; therefore he who eats least eats most.

(*ii*) To be wealthy is not to be healthy; not to be healthy is to be miserable; therefore to be wealthy is to be miserable.

(*iii*) Sir, I admit your general rule,
That every poet is a fool;
But you yourself will serve to show it
That every fool is not a poet. (1918.)

(*d*) (*i*) No cat has nine tails; One cat has one more tail than no cat; ∴One cat has ten tails.

(*ii*) Old age is wiser than youth; we should therefore pay great deference to the opinions of the ancients.

(*iii*) None but the brave deserve the fair; I possess the fair; therefore I am brave.

(*iv*) If you punish your child, he will see you lose your temper, but if you do not punish him, he will continue to be disobedient.

7. Examine the following arguments, pointing out and naming the fallacies, if any:—

(*i*) If their theories were sound, philosophers would agree among themselves.

(*ii*) Good men write good books; this is a good book and therefore its author must be a good man.

(*iii*) No man wishes to suffer pain; your friend cannot be cured without suffering pain, and therefore will not wish to be cured.

(*iv*) If he is not guilty, why did he try to escape as guilty men always do?

(*v*) The explosion was obviously due to gunpowder, as nothing else possesses sufficient force.

(*vi*) In giving advice, you either advise a man to do what he already intends to do, in which case your advice is superfluous, *or* you advise him to do what he is resolved not to do, in which case the advice is ignored.

(*vii*) Not all educated persons spell correctly; for spelling mistakes frequently occur in the papers of Intermediate candidates.

(Al. 1922.)

8. Examine the following arguments, carefully analysing each and pointing out fallacies, if any. Merely mentioning the technical name of the fallacy will receive no credit.

(*a*) Bullies are always cowards, but not always liars. Liars, therefore, are not always cowards.

(*b*) No young man is wise; for only experience can give wisdom and experience comes only with age.

(*c*) In the Happy Valley gardens at Mussoorie, the Municipal Board has put up a notice—'Don't pluck fruits.' I don't see why the gardener prevented me from plucking flowers: the Municipal Board certainly had no objection to it.

(*d*) What every man desires is unquestionably desirable; everyone desires his own happiness; therefore, happiness of the individual is desirable.

(*e*) Improbable events happen everyday; what happens everyday is very probable; therefore, improbable events are very probable.

(*f*) In a valid syllogism, if the premisses are true, the conclusion must be true. It is obvious that, in such a syllogism, if either premiss or both the premisses are false the conclusion must be false.

(g) If the train is late, I cannot reach Allahabad in time for the meeting of the Intermediate Board; if it is not late, I cannot catch the train. But the train will be either late or not late; therefore, in any case, I cannot attend the meeting of the Board. (All. 1931.)